AUG 22 1921

IN THIS ISSUE:

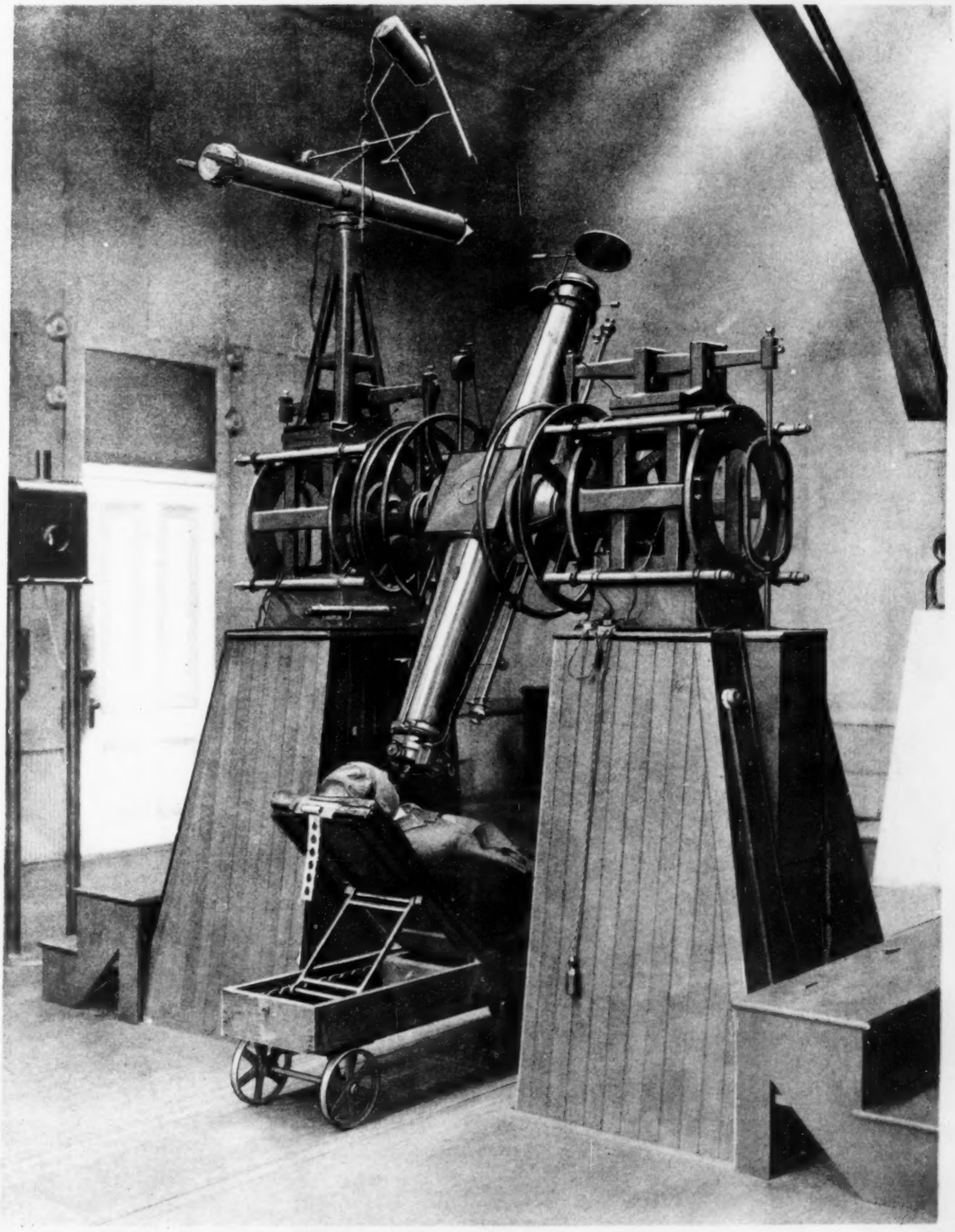
DOING AWAY WITH THE ICE MAN
PAINTING WITH METAL SPRAY

SCIENTIFIC AMERICAN

GENERAL LIBRARY
AUG 22 1921
UNIV. OF MICH.

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS



OBSERVING THE STARS IN ORDER TO DETERMINE OUR STANDARD TIME.

Vol. CXXV. No. 8
August 20, 1921

Published Weekly by
Scientific American Publishing Co.
Munn & Co., New York, N. Y.

Price 15 Cents
20 cents in Canada

A Confession of Faith

GEORGE BERNARD SHAW says —"I am ashamed neither of my work nor of the way it is done. I like explaining its merits to the huge majority who don't know good work from bad. It does them good; and it does me good. * * * I leave the delicacies of retirement to those who are gentlemen first and * * workmen afterwards. The cart and trumpet for me."

That's the way we feel about Williams' Superior Drop Forgings, made to order. We know they're good clear thru from start to finish, and we want others to appreciate their merit also.

DROP—FORGINGS
often cheaper than castings
—always far superior—

J. H. WILLIAMS & CO.
"The Drop-Forging People"

BROOKLYN	BUFFALO	CHICAGO
28 Richards St.	28 Vulcan St.	1028 W. 120 St.

Now Ready

EINSTEIN'S THEORIES
of Relativity and Gravitation

320 pages, 12 mo.

$2.00 net; by mail $2.15

Do you understand Relativity and Gravitation?

—the theories worked out by Einstein that all the world is discussing?
Gain a good understanding of this intensely interesting subject from the new book.
Compiled from the best material submitted by 300 authors in the competition for the Eugene Higgins Prize of $5,000, and edited by J. Malcolm Bird.
It reads like the work of one author, yet contains a breadth of vision and range of viewpoint impossible for one author to attain. At all booksellers

Scientific American Publishing Company
233 Broadway, New York

Behind the Motion-Picture Screen

THE mysteries of the "Movies" are bared at last! It has remained for Austin C. Lescarbours of the Editorial Staff of the Scientific American to undertake the task of answering the thousand-and-one questions constantly being asked by screen "fans" and aspirants to screen careers, in his book entitled, "Behind the Motion-Picture Screen." Among the subjects covered in his work are—

Scenarios. The Director and His Work. Motion-Picture Acting. Motion Picture Cameras and How They Work. The Cameraman. In the Land of Make Believe Studios. Mob Stuff. Tricks of the Screen. Laboratory Work. Pictures

in Natural Colors. Microscopic Subjects. Talking Pictures Animated Cartoons and Sculpture. Motion Pictures in Odd Fields. Motion Pictures in the Home and Business. Present Status and the Future of Motion Pictures.

This book has been written in a simple, interesting, and instructive style. It is not technical; yet it covers all phases of the screen art in an accurate and unbiased manner. Pictures? Certainly; this book is the best illustrated book on the subject—over 300 pictures. Indeed, every right-hand page is a picture page; every left hand a corresponding text page. It is something entirely new in book making. "Behind the Motion-Picture Screen" contains 426 pages and over 300 illustrations, printed on the finest coated paper and bound in an attractive cloth cover measuring 6¼ by 9¼ inches. Price, $3.50 net; Postage Extra.

Special folder containing full description and sample pages, sent on request.

SCIENTIFIC AMERICAN PUBLISHING COMPANY
BOOK DEPARTMENT
Woolworth Building - - - - New York City

SEVENTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXXV.
NUMBER 8

NEW YORK, AUGUST 20, 1921

15 CENTS A COPY
20 CENTS IN CANADA

The Races In the United States

UNCLE SAM'S decennial job of counting noses—and incidentally of making a few observations with regard to the age, race, nativity, and miscellaneous circumstances of the proprietors of the noses—proceeds apace, and has now reached the point where complete tabulation of the returns is possible under certain heads. In particular, the Census Bureau recently made public the figures showing our population, by states, according to race and color.

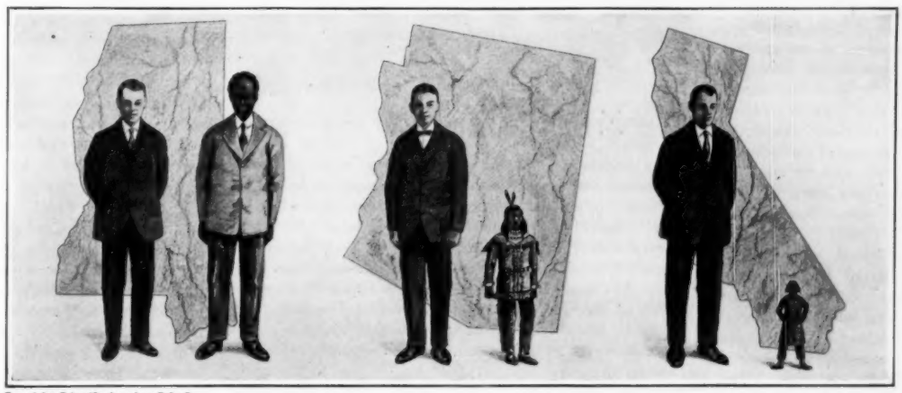
In the United States as a whole, the gentlemen who circulated about the country with pencil and big flat book last year were able to find 105,710,620 individuals. Of these, 94,822,431 are classified as white; 10,463,013 as negro; 111,025 as Japanese and 61,686 as Chinese—making a total of 172,711 for what we may group, in spite of the violent protest made by both elements at such common classification, as the yellow races; 242,959 as American Indians; and 9506 as "miscellaneous" — Eskimos, Malays, etc., etc., etc. Reducing the figures to a more accustomed basis, we find that, ignoring this minute miscellaneous residuum altogether, the Indians make up but 23 one-hundredths of one per cent of our total population, and the yellow people but 16 one-hundredths; so that we need not be surprised to find that the whites, with 90 per cent, and the negroes, with 10 per cent, seem to account for the whole. Or, of every thousand people in the United States, 897 are white, 99 black, 2¼ red, and 1¾ yellow.

The distribution, as every one knows, is not uniform. If we divide the country into three sections, north, south and west, we find that the black men are in the south as we should have supposed, while the yellow ones are in the West, as California would have us believe. The Indians do not permit any such categorical statement; the presence of Minnesota and the Dakotas in the "north," with a few other states in less degree, brings it about that this section has 60,000 aborigines; Oklahoma and North Carolina bring the total of the South up to 75,000; and the remaining 108,000 are in the "West," where we would have looked for them.

It is of interest, perhaps, to compute a few sectional percentages. The South, comprising everything south of the Mason and Dixon line and the northern line of Arkansas and Oklahoma, has 27 per cent of its people negroes and the remaining 73 per cent—neglecting the few of other races—white. For the North barely two per cent of the population is black, and for the West a bare 8/10 of one per cent.

More illuminating figures may be obtained if we take individual states. Two states have a majority of their residents from the black race—South Carolina and Mississippi. The latter-named state shows the larger proportion, with 94 negroes to 85 whites, or 52 per cent black. This is one of the states showing a decrease in population for the decade since 1910, and an examination of the figures shows this decrease to be attributable to the black population, which has fallen off by 74,000 while the whites were increasing by 6800.

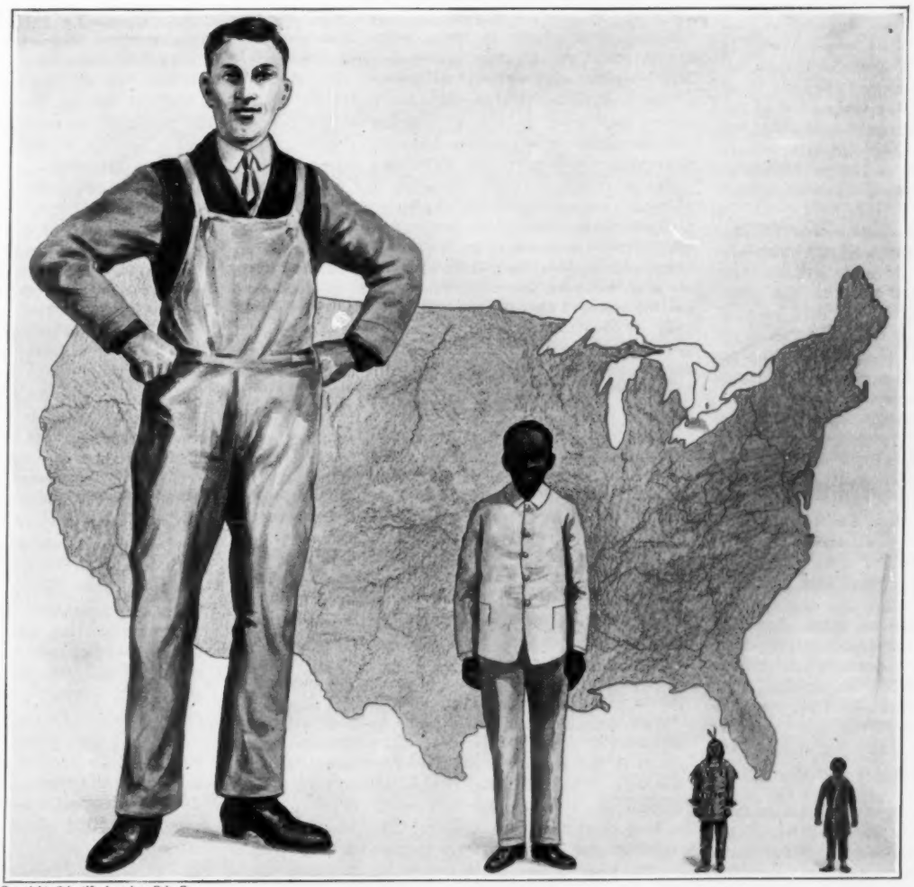
Everybody, we believe, knows that the two states mentioned as having the greatest negro population are as they are. Most of us are sufficiently informed that California has the heaviest percentage of yellow residents. We should, however, probably be hard put to it to guess where the Indian bulks the largest. The answer is in Arizona, where there are three red men to every 29 whites—the Indians constituting very close to ten per cent of the whole population. Applying the same process to the Chinese and Japanese of California, we find that this state has one yellow man to every 32½ whites; which is to say, the oriental races constitute a trifle less than three per cent of the state's total. These are the figures which are displayed graphically in the drawings on this page, the (three-dimensional) bulk of the manikins being in proportion with the numbers which they are designed to represent.



Copyright, Scientific American Pub. Co.

Left: Mississippi has somewhat more black residents than white. *Center:* It is in Arizona that we find the greatest proportion of Indians. *Right:* In California, where the yellow man is most seen, he bears the ratio to the white residents indicated by a comparison of the two figures shown

The States that have the greatest proportion of non-white residents of each category, and how they show up on actual comparison



Copyright, Scientific American Pub. Co.

The relative proportions of the white, negro, Indian, and Japanese-Chinese population of the United States is indicated by the bulk (not the height) of these figures

THE SCIENTIFIC AMERICAN, August 20, 1921. Volume 125, Number 8. Published weekly by Scientific American Publishing Company at 233 Broadway, New York, N. Y. Subscription price, $6.00 per year.
Entered as second-class matter June 18, 1879, at the post office at New York, N. Y., under the act of March 3, 1879.

SCIENTIFIC AMERICAN

Published by Scientific American Publishing Co.
Founded 1845
New York, Saturday, August 20, 1921
Munn & Co., 233 Broadway, New York

Charles Allen Munn, President; Orson D. Munn, Treasurer
Allan C. Hoffman, Secretary; all at 233 Broadway

Entered at the Post Office of New York, N. Y., as Second Class matter. Trade Mark Registered in the United States Patent Office.

Copyright 1921 by Scientific American Publishing Co. Great Britain rights reserved. Illustrated articles must not be reproduced without permission.

The World at the Crossways

IF a traveller from one of the planets were to light upon this world of ours, coming with a mind free from prejudice and eager to learn the exact truth about us, and if the visitor were to pick up one of our school histories of fifty years ago, he would get the impression that the principal business of men had been that of fighting. If he chanced upon Bernhardi's ridiculous book, and read therein that war is a biological necessity, he would doubtless exclaim: "Exactly! The history of the people of this planet proves it!" Those of us who studied the school history books of the last century (we believe that they have been rewritten and are better balanced now) received the inevitable impression that down through the centuries fighting, military expeditions, conquests, and so forth, were the most important business of life, and that other matters were of subordinate importance. Histories are better written today, and such model work as Breasted's "*Ancient History*" gives a well-proportioned and admirably balanced view of all the activities of our ancestors, not merely in war, but in religion, social economy, science and industry.

Of all the breeders of war, ignorance and fear stand first. Ignorance breeds fear and suspicion. Fear and suspicion breed war. So it ever has been and, alas, so it is today. Who was it who said that he could hate a man intensely until he met him, looked into his eyes, and held speech with him, and then, more often than not, his hatred was dissipated as a morning mist is thinned out by the morning sun? We take it that one of the most hopeful signs of the day, particularly in international affairs, is the growing recognition of the "get-together" idea. As between man and man, we have practised it for centuries. Now, at last, we are beginning to realize that it may be just as efficacious in the settlement of disputes between those aggregates of men which we call nations.

Today, the nations are at the crossroads of history. That is the meaning of the momentous call which our President (who grows daily in the confidence and esteem of his people) has sent forth to the great nations of the world. We are among that growing number who believe that the conference which is to assemble on Armistice Day is destined to stand as one of the great milestones in the progress of humanity from ignorance, suspicion, hate and war to a state of peace, founded upon reasonable compromise and a regard for the fundamentals of justice.

The keynote of this gathering will be struck by the United States, and upon the spirit and point of view with which we enter the council chamber will depend the success or failure of the whole conference. It is absolutely essential that our representatives approach the forthcoming discussions with an open mind; also, we must credit the other four nations with the same attitude.

Nothing would kill the conference more effectually than a repetition of the recent fatuous talk about our rushing the 1916 program to completion, so that we may enter the conference with the prestige of an unequalled battleship force behind us. That would be fatal. That would be to carry a "big stick" into the conference. We would excite that very distrust and suspicion which President Harding has called this conference largely to allay.

America is presented in this matter with a magnificent opportunity. Let us say to the delegates: "Gentlemen, we have come here, not to propose the entire abolition of armaments. That would be impossible. But we propose that the delegates here assembled make such a full, clear and honest declaration of their several aims and policies, that it will be possible so to adjust them, that our navies can be reduced to a mere police force, cooperating to make secure the highways of the seas, and provide safe passage for all who may wish to come and go thereon."

The Use of Useless Things

PARADOXES are no doubt for the most part merely verbal. They arise from incorrect or inconsistent use of words, or from misconceptions regarding their true and full meaning. What things are useful? First, of course, the so-called necessities of life—food, clothing, shelter. Then, those things which alleviate pain or save endangered life: the physician's kit of instruments and drugs. And the list can no doubt be extended along this line, things as to the utility of which practically all are agreed.

But what of amusements? Or, higher in the scale of things, what of art and science? Not technology and science as the handmaid of the "useful arts," but science as the goddess worshipped by her devotees without necessarily any thought of immediate or even of ultimate application.

To the person devoid of musical ear and understanding surely a symphony orchestra must present a ludicrous spectacle. A band of men, fifty, sixty or more, assembled on a stage, and going through meaningless motions for an hour or more at a time, producing an equally meaningless series of noises. And all this with a seriousness which would seem to call for some weighty circumstance as either its cause or its purpose. Yet no such circumstance is in sight. Surely the antics of the conductor are not sufficient to account for all these men behaving in this singular fashion. And the audience. Patiently and in silence they sit through the performance, and at the end return to their respective homes after having spent what must appear to our tone-deaf friend a most unprofitable, a thoroughly wasted afternoon or evening.

But what, fundamentally, is useful? The things that make life possible? Yes—but only on one condition, namely, that life be worth while. Men have sought to justify the pursuit of pure science by its "practical results"; by the fact, clearly discernible in history, that all scientific knowledge sooner or later finds "useful application," no matter how far removed from industrial pursuits the cloistered academician may have started the spinning of the thread. The seemingly most useless inquiries presently find their use, even in a crudely utilitarian sense.

But is, really, any such advocacy, any such defense of the pursuit of science for its own sake needed? The attitude of the mind which demands such justification, what does it amount to in the last analysis? It asserts nothing less than this: That eating, drinking, sleeping, in short, the satisfaction of the primal needs are the warrant for all other pursuits. In other words, that we live to eat.

But, some will say, art, music, literature, these things appeal, if not to all at least to great numbers. Pure Science, on the contrary, is the pleasure of a privileged few, of a highly exclusive aristocracy of intellect.

This need not be so. There is much of the fascination of science that can be communicated by the expert to an audience of lesser attainments, as the virtuoso delivers his message from the Muse to the common mortal. True, perhaps, that men of science have been somewhat neglectful of this obligation (for it surely is an obligation) to their fellows. Their work is very arduous and we cannot be very severe in our criticism of them in this matter. Only, it does appear worth while to point out that they would undoubtedly find, for any efforts thus spent, a fitting reward in the increased appreciation, on the part of the public, of their work and its products.

And, granting that at the best the great, the deep pleasures of scientific discovery and contemplation are reserved for a few, is this really a disqualification for such pleasures to be weighed in the plea for the pursuit of science for science's sake? Is this a matter to be decided purely by numbers? If it should be found by count that Hottentots are the most numerous tribe on the face of the earth, should we therefore adjust all our doings and strivings to the Hottentot's standard of what is most worth while?

Surely the right standard to adopt in such matters is to be guided by that fine sense of values, that keenness of perception, that intensity of feeling which is the mark of the great. For it must ever be that the general average of excellence in a community is upheld and advanced by the exceptional few, the leaders in thought and deed; men in whom the flame of life burns fiercely, the light of reason glows undimmed.

Natural Selection While You Wait

THE man who keeps his eyes, and beyond his eyes his mind open to what is going on around him, finds that life is full of things to speculate about. In particular, he finds that the man-made processes of civilization have a very immediate bearing upon the ordinary, unhindered acts of Nature—sometimes falling in in a surprising manner with her way of doing things, sometimes modifying her procedure in a fashion more or less pronounced but always interesting, and sometimes merely touching her in an unexpected spot.

In common with the porcupine, the turtle has been blessed by nature with a sort of immobile security that stands out sharply in distinction against the speed and the active fighting ability with which she protects most of her creatures against their foes, and on the other hand against the mere vast powers of multiplication with which she insures the perpetuation of her more helpless species. To confine our attention to the animal that is on our mind, it is conceivable that the turtle might be wiped out by a change of environment that would deprive him of food or subject him to unaccustomed temperatures. It is even imaginable that an active enemy might appear, capable of finding him with sufficient frequency and crushing him in a powerful jaw with sufficient effect, to make him ultimately obsolete or at least obsolescent. But it hardly seems reasonable to imagine that a systematic occurrence of the same accident could possibly catch up with the turtle often enough to destroy large numbers of this animal and to suggest that he may be on the way to ultimate extinction.

Nevertheless, the turtle is today, in the east at least, succumbing to such a combination of circumstances in sufficient quantity to suggest that in the long run a definite result may be achieved upon the perpetuation of the species. During the past twenty years man has found it necessary to honeycomb the countryside with a network of hard strips of asphalt, brick, concrete and macadam. Over these roads there pass, at high speeds, juggernauts of a weight matched by few of nature's creatures, and by none in this part of the world. Fast moving animals like the squirrel and the rabbit, possessing the instinct of flight from danger that accompanies speed, are not affected by this; what motorist ever achieved the running over of a rabbit? But the turtle, moving with extreme deliberation, and merely retiring into his shell in the presence of danger, is in quite a different situation. In a free state of nature, it would take the rare combination of a rock beneath him and an elephant or a land-slide above him to crush the life out of Mr. Tortoise; when he gets squeezed between a speeding car or truck and the hard road there is a different story to tell.

This is by no means an idle flight of fancy. Every eastern motorist must have noticed that in the spring and early summer, after a rain, the turtle, like the chicken, is possessed of a mania to cross the road. On a three-mile drive we have counted as many as a dozen of them engaged in the hazardous procedure. In the same distance we have counted the remains of four, marking the spots where drivers failed to see them or copied their refusal to dodge. We are sure that since the early spring of last March we have seen more dead turtles in the roads than live ones in the fields, woods and streams. If it is not an actual modification of the turtle's environment that is taking place, to his ultimate destruction, it is at least an interesting illustration, on a small scale, of the sudden and unexpected quarters from which such changes may fall, of the obscure causes which we must sometimes search out for the disappearance of past species, and of the rôle which man in his domination of the earth may play as an accelerator of nature's great game.

Electricity

Lightning and Radio.—In a recent severe electrical storm the Navy radio station at Arlington was struck by lightning and had temporarily to suspend operation. Men were at once set to work to put the plant back into operation, and the interruption was of short duration. No one was injured by the bolt.

A German Hydro-Electric Project.—The possibilities of large water powers along the Main-Danube Canal in Bavaria have been investigated and are set forth in a recent issue of *Elektrotechnische Zeitschrift*. The canal in its present form would yield about 100,000 horsepower, but with some additions and connections with other watersheds up to 1,000,000 horsepower may be obtained.

Scottish Water Power Schemes.—From the *Engineer* of London we learn that it is proposed to utilize the yield of a catchment area in the vicinity of Loch Laggan and Loch Treig in which the annual rainfall is probably fully 70 inches. The average available head at the turbines will be nearly 700 feet, giving an average development of 72,000 horsepower. The works will be constructed so that over 100,000 horsepower can be developed when sufficient water is available.

A Transmission Feat.—The Pit River hydro-electric development of the Pacific Gas and Electric Company of California will feature power transmission at 220,000 volts. This will be the greatest transmission line, from a point of voltage, which the engineering world has yet developed. It is reported that 10,000,000 pounds of bare copper cable will be used in this construction. The Pacific Gas and Electric Company's engineers have decided upon the use of a 500,000 cm. 49-wire medium hard drawn cable made up of seven-wire strands rope laid for the main power line, which will extend a distance of 180 miles, from the Pit River Falls to Cordelia, Calif.

Interesting Lamp Facts.—In the vacuum-type lamp the 40-watt size is used to the greatest extent, it representing about a quarter of all lamps of this class. The 25-watt is a good second, followed by the 60-watt and the 50-watt. A tendency to standardize the last-named size accounts for a very perceptible increase in its use during the last two years. Meanwhile, continues *Electrical World*, the gas-filled lamps of 75 watts and 100 watts have risen in popularity, while little change is shown in the larger sizes. It now looks as if the two sizes just mentioned would very rapidly drive out the 100-watt and perhaps the 60-watt vacuum lamps. For street-lighting work the vacuum type has virtually disappeared. The three voltages most generally used, including three-fourths of the whole number of lamps, are 110, 115, and 120. The use of the last two has grown at the expense of the first within two years.

St. Lawrence Project. — The International Joint Commision recently received the report of Col. W. P. Wooten and W. A. Bowden, the engineers appointed respectively by the American and Canadian governments to make a survey of the possibilities of canalization of the St. Lawrence as a means of shipping and the relation thereto of hydro-electric power. They report that the work would cost $250,000,000 and would result in the development of 1,700,000 horsepower at the ten locks planned. Plans are submitted for 25 to 30-foot depth waterways 120 miles long. According to *Electrical World*, four methods are suggested: (1) Locks and navigation dams in the river, (2) locks and side canals, (3) a combination of the two previous, and (4) by means of locks and power dams. The report recommends a combination of the four, declaring that the power so developed would pay for the entire project in a few years.

Tasting Radio Signals.—Two radio engineers, Alfred N. Goldsmith and Edward T. Dickey, have recently conducted a series of experiments with the object of determining the feasibility of reception of radio signals by the sense of taste. Electrodes were made which could be placed under the tongue in such a way as to cause a taste sensation when a source of potential was connected to them. Tests were made, using low potential direct current and 60-cycle alternating current, to ascertain the amount of energy and potential necessary for taste reception. The reception of actual signals from an antenna was tried. It was found impossible by using four stages of amplification to obtain taste sensations from all signals the audibility of which was greater than 500 in the detector circuit. The results obtained thus indicate that while from an electrical standpoint it is possible to receive radio signals by the sense of taste, the sense of taste is much inferior to that of hearing or even of sight, as a method of reception.

Science

Gondolas for the Thames.—Gondolas, those fascinating water taxis of Venice, are to be put into commission on the Thames. A local London builder is fabricating a fleet from real Venetian models. All the comfortable fittings will be provided.

Army Forts for Sale.—All the old Army forts which have not sufficient historic value and which are useless are to be sold by our War Department. These holdings are of no use to the Government; in fact, they are only an expense, and the land might just as well be turned into money.

A New Alberta Rye, Rosen, originating from seed imported from Michigan, and introduced by the Noble Foundation, has shown peculiar aptitude to climatic conditions here and will become a standard crop. It graws well in dry soil, out-yields the ordinary varieties, and stands up well aganst frost.

Shackleton Again To Explore the Unknown. — Sir Ernest Shackleton is to make another expedition to the Antarctic, this time for more leisurely exploration than for a wild dash for the South Pole. His ship, the "Quest," is only 111 feet long so she can turn and twist in the ice. The scientific results of the expedition will be awaited with interest.

Military Tanks Check Heath Fires in England. — Military tanks are being used to check heath fires. All efforts to stop the flames near Aldershot failed until a detachment of tanks crawled out and the tank crews sprinkled water and chemicals on the fire and cleared the way for the fire fighters as though they were dealing with machine gun nests in Flanders.

German Toy Makers Coming.—Over eighty villages in Germany specialize in toy making and this local industry has suffered a great deal on account of insufficient foreign orders, while the expert toy makers are emigrating to England and are also getting to America somehow. Nuremburg is the center of the toy industry and this city is also suffering from lack of tourists, as toys and tourists are the two principal sources of prosperity by which the quaint old Bavarian city exists.

Government Guards Private Forests. — An agreement has been made by the Forest Service of the United States Department of Agriculture and a lumber company of California, by which the entire fire protection of about 800,000 acres of timberland owned by the company will be undertaken by the Government. The cost will be about $12,000 a year. This means that every precaution known to the Forest Service, both for preventing and fighting forest fire, will be used. Airplanes will patrol the timberlands and every forest ranger will be a fire warden.

Canadian Hemp.—A recent hemp "breaking" demonstration given at Winnipeg proved conclusively that hemp can be successfully grown in western Canada, and that a machine has been invented capable of converting the hemp stalks into marketable hemp fiber which can be manufactured into practically anything from the coarsest rope to the finest linen. The demonstration was conducted by Col. William Grassie, D.S.O., president of the Canada Fiber Product Company, and the hemp was grown at the Manitoba Agricultural College and lay under the snow all winter.

Irrigation and Drainage Education.—A course giving a general knowledge regarding irrigation and drainage has been added to the curriculum of the University of Alberta. The engineering aspects of irrigation will not be touched upon to any great extent, and the student's studies will be confined to the history of irrigation, kinds of irrigation, source of water, measurement and distribution of water, character of water used and its effect upon soil, crops, etc. No other Canadian educational institution has previously offered courses which covered the field of irrigation.

Progress of the Mount Everest Expedition. — The last report received via Simla under original date of June 10 outlines a tale of hardship and disappointment, which was what was to be expected. The transport service broke down early in the expedition, which hampered the explorers very much. Dr. Kellas did not recover from the hardships in climbing the snows and had to be carried in an arm chair by coolies, and he died suddenly while crossing a pass. He was buried on a slope overlooking Mt. Everest which he was so eager to climb. Everything is on such a gigantic scale that the human mind is appalled. Great precipices 7,000 feet deep are constantly encountered. The clouds are wonderful and the coloring of the landscape is beautiful. Nature's one last stand can only be conquered by the expenditure of blood and treasure, but the knowledge which is being obtained is worth the price.

Industrial Efficiency

British Columbia's Lumber Trade.—A good feature of the lumber industry in British Columbia during the month of June was the well-sustained export demand, especially for the Orient. The June shipments to the offshore countries will total about 20,000,000 feet. These shipments have been destined to Japan, China, South Africa, Australia, New Zealand, Egypt, California, Mexico, Chile and Peru. Shipments to eastern Canada by water via Panama are a new feature of the business, and will become regular if vessels maintain the run between Vancouver and Montreal, which depends upon the availability of cargo westward.

Pilfer-Proof Packing Case. — The increase in the pilferage of goods in transit in the United Kingdom has led to the invention of a special packing case which is said to be pilfer-proof. Among other advantages claimed for it are: 1.—The additional cost of construction is small. 2.—It is 100 per cent stronger than ordinary cases. 3.—As no battens are employed, the shipping measurements are not increased, consequently a saving in freight is effected. At a demonstration before the London Chamber of Commerce a sample case is said to have "resisted all efforts to get into it for 20 minutes, and could not be reclosed without leaving very clear signs of its having been forced."

Alcohol as Locomotive Fuel.—From Pernambuco in Brazil comes the news that there are approximately 80 modern cane-sugar factories, which have about 800 miles of railway, of from 0.75 to a 1 meter gage, operated at present by wood-burning locomotives. The fuel problem, however, is becoming a serious one and as a result the sugar-mill operators are turning their attention to reducing wood consumption and finding substitutes. Consequently great interest is being shown in the substitution of alcohol, which is produced in large quantities on the sugar plantations from the molasses finals. Pernambuco has recently adopted the use of alcohol to which 5 per cent. gasoline has been added, as an automobile fuel. There is considerable interest now in obtaining locomotives that can operate on this fuel.

From Harmonicas to Airplane Propellers.—Industrialists must do some pretty quick thinking and still quicker deciding in these uncertain days in order to keep their plants in operation, especially when trade is very slow. From Japan comes the report of an extreme case in industrial rearrangement to take care of abnormal conditions. A Japanese company manufacturing pianos and organs had to be turned into an airplane propeller factory. It is understood that this factory, in addition to the manufacture of pianos and organs, developed since the outbreak of the war a large export business in harmonicas, chiefly from the United States. In recent months it has encountered such formidable competition from German goods, said to be better and cheaper, that it decided to initiate this new business.

Training for Ex-Service Men.—The British Ministry of Labor has had good results in the training of disabled ex-service men. At present there are fifty ex-service men in training in the following rural crafts, at one of the many Government instructional factories: 1.—Woodworking, including vehicle repairing and farm and estate carpentry; 2.—Metal working, including smithing, agricultural implement and motor tractor repairing; 3.—Leather working trades, including saddlery and the repairing of harness. This is but one of the numerous instructional factories throughout the United Kingdom. Most, if not all, of the workers are suffering from some disablement. There are over 100,000 ex-service men in training at these factories in various parts of the country and there is provision and accommodation for 200,000.

Germany's Opportunity. — Whatever may be the political outcome of the Peace Treaty, one thing is certain, and that is the advantage enjoyed by German industrialists and traders at this time. Relief from huge naval and military burdens, together with the low value of the mark abroad, enables German manufacturers to introduce their goods in foreign countries at prices that defy competition. Indeed, the manufacturers of England, France, Belgium, Italy, the United States and even Japan are in many instances helpless in the face of German competition. As long as Germany sells, she gains by the exchange. Her industrialists are seeing to it that they are generally the sellers and rarely the buyers, since when they buy the exchange works against them. Most German products at present are made from strictly German raw products. As for the Allied export tax, the German industrialists simply charge that much more for their products, which are still low enough in price to compete with those of other countries.

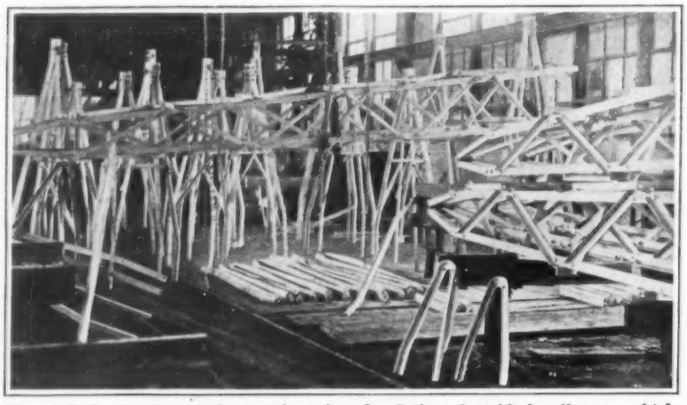
Painting with Metal Spray

How Protective Coatings Are Shot Into Place Under the Latest Procedure

By Robert G. Skerrett

ELECTROPLATING and galvanizing are well-proved and widely applied processes that have many fields of usefulness. Indeed, they would be resorted to far more extensively if there were not conditions that make this prohibitive. That is to say, many metal articles might be plated to advantage if their basic substances could resist the while the corrosive attack of the electrolyte employed; and the size and structural get-up of other metallic bodies are such that it is commercially impracticable to provide a zinc bath large enough to admit of their treatment.

Nevertheless, metal coatings have been devised that are handled more or less like paints, and to a point these have served fairly well although admittedly not as durable or satisfactory as the shielding film deposited electrically or by dipping in a bath of molten metal. The fundamental weakness of these painted-on or stuck-on coatings has been the lack of intimate union between the underlying and the attached metals. However, years of scientific research and inventive cunning have finally brought to a truly commercial stage a flexible system which makes it possible to form a covering film by spraying melted metal upon a variety of surfaces for protective or decorative purposes. In this the achievements of M. U. Schoop, of Zürich, Switzerland, are conspicuous.



Transmission towers and spreaders for the Swiss electrified railways, which were galvanized by the spray system

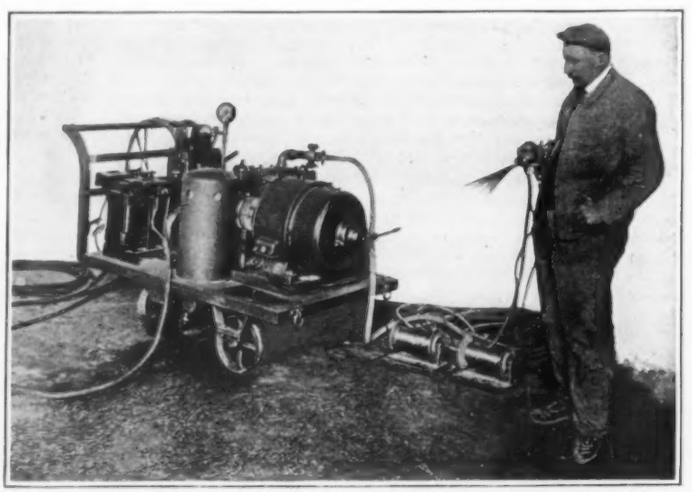
The SCIENTIFIC AMERICAN has previously described the Schoop process—the last article appearing a little over six years ago. Since then this ingenious engineer has pushed steadily onward, improving the while earlier apparatus and creating still newer instrumentalities that add greatly to the capabilities of his spraying method. For a time Schoop relied upon an oxy-hydrogen flame either to melt powdered metal or to fuse a wire which, while in the molten state, was atomized by a stream of compressed air and driven at considerable velocity against the surface to be coated. Now, he employs an oxy-acetylene jet, and this has proved quite 50 per cent superior. The higher temperatures obtained in this way insure better results, give the metal coating pistol a longer effective range, and make it feasible to handle efficiently metals differing widely in their melting points.

A terra-cotta box that has been bronzed by the spray method

A few years back the somewhat delicate mechanism that fed the wire into the flame of the blowpipe was operated by a small pneumatic turbine which made about 28,000 revolutions a minute. This meant that a rather complex reduction gear was required in order to transmit a far more sluggish movement to the fusing wire. The commercial demand was for a pistol of really rugged construction which could be entrusted to the average workman and his commonly unskilled manipulation. To this end, a pistol has been produced which is equipped with an air-driven Pelton wheel which makes between 4000 and 5000 turns a minute. The wire-feeding feature is, in consequence, now reasonably robust, and the speed adjustment of the feed is simplified to a marked extent.

But probably the greatest step forward has been in the substitution of the electric arc for the gas flame. In the "Electro-pistol," which functions with either direct or alternating current, two wires, moving toward each other, form part of the circuit. The two free or open ends of this circuit are brought together and then separated just far enough to induce an arc; and this distance is maintained as the wires are uniformly fed into this arc and fused. At the same time, the melting terminals are swept by a jet of compressed air, and this atomizes the metal and drives the plastic globules against the surface to be coated. The temperature of the arc is higher than 5400 degrees Fahrenheit and, therefore, sufficient to permit the melting and spraying of platinum, molybdenum and other very refractory metals.

The electro-pistol weighs only 3.3 pounds, uses 40 amperes of current at from 25 to 30 volts, and calls for an expenditure of 17.6 cubic feet of compressed air per minute, which is supplied at a pressure of 3 atmospheres. In this connection it is interesting to note that Schoop has found, in the course of his developmental work, that it is not essential to employ an air impulse of very high pressure to get a spray fine enough for his purpose and to propel the metal particles a suitable distance from the pistol to the object to be treated. Originally he experimented with pressures ranging from 35 to 40 atmospheres, and these he stepped down to 12 atmospheres with which he practised for some time. Later on with proper facilities, air at 6 and 7 atmospheres answered. At present there are in service many hundreds of his various types of metal-spraying pistols that are operating satisfactorily with an air impulse of 2½ or 3 atmospheres.



A portable plant for the operation of the "electro-pistol," making it possible to deal with structures heretofore inaccessible

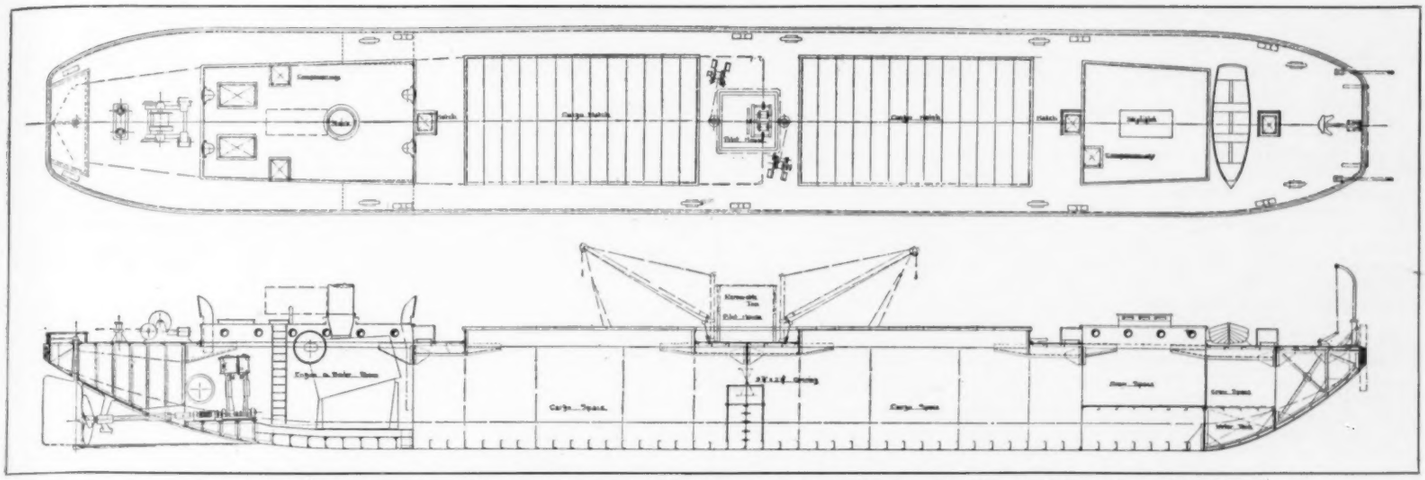
Ten years ago the efficiency of the Schoop-spraying apparatus was comparatively low, for then, of the total volume of metal heated and sprayed, only 30 per cent was deposited, the remaining 70 per cent being dissipated in the atmosphere and in a way to interfere with the breathing of the operative. The pistols now in use are able to deposit 90 per cent of the metal atomized; and in the case of aluminum the factor of efficiency is 95 per cent. In the past only tin, lead, and zinc could be handled, but the list of metals that can now be precipitated by the process is a far longer one—in fact, it includes any that can be fused by either the oxy-acetylene flame or the electric arc.

In 1912 Schoop demonstrated that it was feasible to melt, to diffuse, and to deposit enamel, glass, quartz, etc., on suitable bodies, but he elected at that time to devote all of his energies to the problems relating to metal spraying. Within the past year, however, he has again taken up enameling, and his accomplishments open up new avenues of application for his broad system. Even when silicate of lead is added to reduce the melting point of enamel or glass, still temperatures running from 1112 degrees to 1292 degrees Fahrenheit are necessary, and it is therefore practicable to coat only materials that can withstand exposure to that heat without injury. The surfacing substance may be in a powdered or granular state or it may be in some other form which is not so readily fused. Care has to be taken to see to it that the driving medium, compressed air or inflammable gas, shall be so controlled that it will not exert a troublesome cooling effect before the vitreous material has reached the object to be covered.

It seems that by the admixture of coloring matter it is possible to give the enamel or glaze any desired tint; and there is reason to believe that this new evolution of the process can be used to advantage both in the field of art and in many departments of industry. The glaze or enamel imparts a brilliant and beautiful finish, according to the composition. Not only that, but the coatings are of a pronounced refractory character. Indeed, tests have repeatedly revealed that tin and other metals so enameled can be heated to redness in a Bunsen flame and then plunged directly into cold water without causing the film to peel off or crack.

As the Schoop system stands at present, the spraying pistols are of three types; and, whether the heating agency be oxy-acetylene gas or electricity, they render it feasible to deal with powdered metal or wire or vitreous substances. Each pattern of pistol has its virtues, and, therefore, is able to meet special requirements or conditions. These several apparatus may be operated from stationary or portable plants. The portable equipments are

(*Continued on page 137*)



Plan and sectional view of one of the new Government-built barges to be employed on the New York State Barge Canal

Self-Propelled Steel Barges for the State Barge Canal

WE present drawings showing the characteristics of the twelve self-propelled steel barges, which the United States Government built recently for service on the New York State Barge Canal. We confess to a liking for these craft; they should prove to be well adapted for their particular work. They are intended to serve as tow boats, handling from three to six barges, and to be able, themselves, to carry about three-fifths of the load of a non-propelled cargo barge. Three of the cargo barges in consort with one of these tow barges will be able to pass through the canal in single lockings.

The general dimensions are: Length overall, 150 feet; beam, 20 feet; depth, 12 feet. The hull of the tow barge is similar to that of the steel cargo barges, of which there are 51, the dimensions being the same. It should be mentioned that the construction of all these barges is very rugged, with the expectation that they will be operated in Long Island Sound, New York Harbor, Hudson River, and Chesapeake Bay, during the winter months after the close of navigation in the Barge Canal. They could also be transferred, coastwise, to other waters if it should be so desired.

The fore peak of the barge forms a single reserve feed-water and trimming tank of 7050 gallons' capacity. Abaft the peak bulkhead and under a steel trunk is a space 22 feet long extending the full width of the vessel, which is devoted to crews' quarters and is certified for twelve seamen. It is divided into mess room, two officers' double staterooms, galley, toilets, showers for both officers and crew, and a forecastle with berths for eight men. Then, going aft, we find two 38-foot cargo hulls with a 14-by-26-foot hatch over each. Abaft of these is the machinery space, 26 feet long, under a well-ventilated steel trunk. A fuel-oil compartment 12 feet long, divided longitudinally into two tanks is located in the after end of the vessel. The combined capacity of the tanks is 12,200 gallons. The pilot house is located amidship. It is built in two sections, so that the upper half may be removed in exceptional circumstances, to give clearance under low bridges.

Two portable steel derricks of 500 pounds' lifting capacity are placed one forward and one aft of the pilot house. Leads from the derricks run to two 3-by-4, double-cylinder, single-drum winches on deck near the pilot house. The smokestack is arranged to hinge back on the engine trunk.

An 8-inch by 10-foot, double-cylinder, single-drum winch is located abaft the engine room trunk for towing and warping.

The double propellers are four-blade cast-iron. Two balanced rudders are provided and the tillers are yoked together so that their operation is identical and simultaneous.

The tow barges are driven by vertical fore-and-aft compound engines, and steam is supplied by a water tube boiler at 225 pounds' working pressure. The net cargo capacity is 390 short tons on a mean draft of nine feet in fresh water. The estimated speed of the vessels in light condition is ten knots.

A Few Facts and a Little Fancy

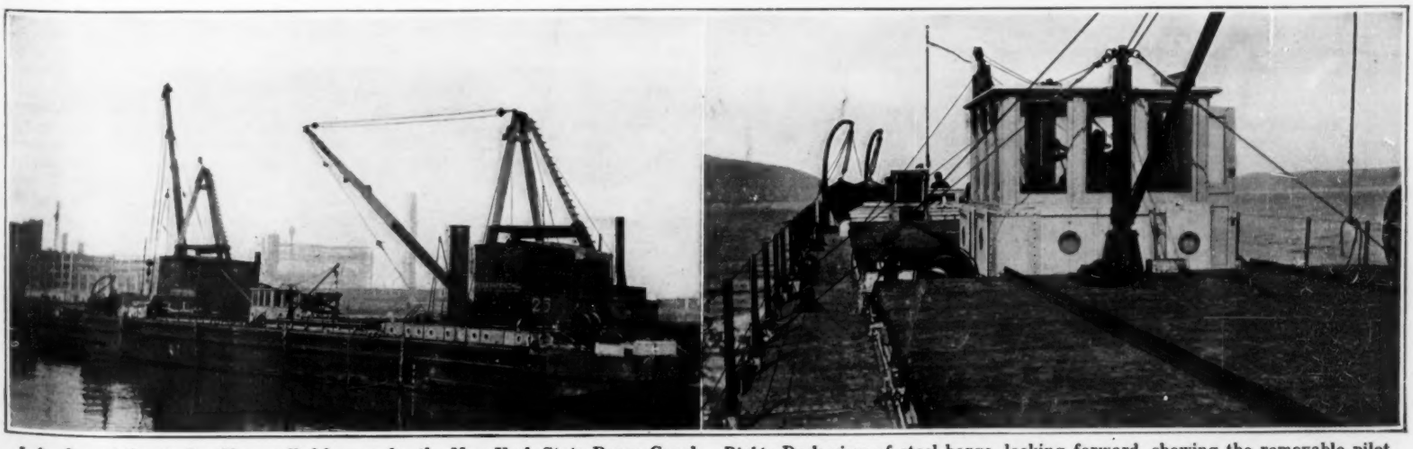
THAT iron is stronger than wood seems too self-evident to warrant consideration, yet flywheels are often constructed of wood because they can be run at a higher speed than iron without danger of bursting. The mathematical explanation of this apparent absurdity lies in the fact that the stress tending to burst the wheel increases with the weight and the square of the velocity. The velocity at which the wheel will burst is therefore dependent on the square root of the strength divided by the weight. As the strength of maple wood, for example, is 10,500 pounds per square inch and its weight only 0.0283 pounds per cubic inch, giving a quotient of 371,024 while the strength of cast iron is 20,000 pounds per square inch and its weight 0.26 pounds per cubic inch, giving a quotient 76,925, it follows that so far as strength and weight of materials is concerned, maple flywheels will stand a speed approximately the square root of the ratio of these two quotients or about 2¼ times greater than cast iron wheels. Even when the greater difficulties of designing and constructing wooden wheels, necessarily made of a large number of comparatively small pieces of wood, are taken into account they may be so designed as to be operated safely at a speed 50 per cent higher than that of cast iron wheels.

The speed of flywheels is often as high as a mile a minute and in some instances nearly three miles.

It is difficult to realize the amount of energy in a rapidly revolving flywheel because it does not appear to move. If, however, it is possible to imagine one of these wheels thirty feet in diameter, weighing many tons, rolling along a city street at from one to three times the speed of the fastest express train, it will not require a much greater stretch of the imagination to grasp what would happen if it encounters a factory building in its path. Its destructive power, however, will be no greater than that of a bursting flywheel of the same size and revolving at the same speed.

To turn all of these flywheels, boilers containing still greater stores of energy are required. It has been estimated that every cubic foot of water in an operating boiler contains as much pent-up energy as a pound of gunpowder. The explosive effect of even a comparatively small boiler such as is used for power purposes would, on this basis, be equal to that of about 200 pounds of powder which would be sufficient to project the boilers to a height of about two miles.

With all these deposits of pent-up energy around us, in the factories or office buildings where we work, in the hotels in which we dine, the apartments in which we sleep and under the sidewalks on which we walk, it may be excusable for us to allow our usually well-behaved imaginations to picture for us what a glorious event for a Fourth of July celebration it would be for all of the boilers and flywheels now industriously engaged in making the commercial and industrial world move, to go on a strike, so to speak, or, better still, decide "to start out for themselves."



Left: One of the steel, self-propelled barges for the New York State Barge Canal. *Right:* Deck view of steel barge, looking forward, showing the removable pilot house and one of the two portable steel derricks

Housework in the Laboratory

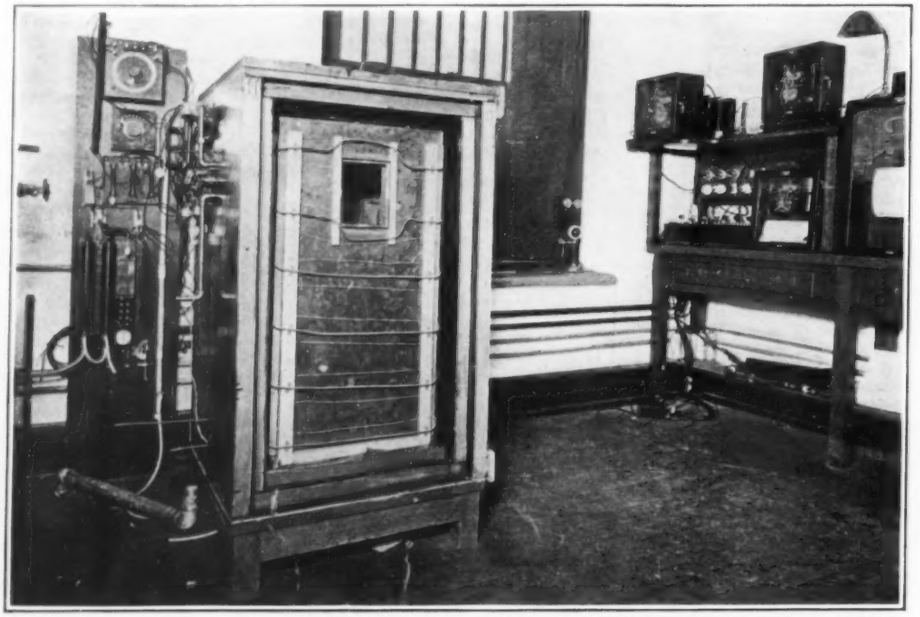
What the Government Tests Have Revealed Regarding the Energy Expended by the Housewife in Her Daily Work

By S. R. Winters

SOMEBODY who sympathized with the drudgery of the housewife voiced the sentiment that man worked from sun to sun while woman's work was never done. Irrespective of the literal truth of this poetic expression, the variety and frequently irksome tasks incident to the care of the household are not to be gainsaid. Knitting, washing, ironing, sewing, crocheting, sweeping the floor, dishwashing, and dressing infant members of the home, are duties that entail a varied and specific service. The labor required for each task is not measured by the worker, the energy expended during the day perhaps being roughly computed in the implied or expressed feeling at bedtime, "I am tired."

The variations in the energy expended in manipulating a 5-pound iron, scrubbing a floor, knitting a sweater at the rate of 23 stitches a minute, rubbing a towel on a board 40 times in 30 seconds, washing dishes, dressing an infant, and other manifold household duties, comprise a subject which is interesting to contemplate in its details. Or, even more stimulating to the imagination and thought-provoking is the comparative study of the energy dissipated when a woman is comfortably resting in a swivel-chair and the calorie requirements when lending herself unreservedly to the tasks of the household. This hitherto speculative subject, in its many ramifications, has been translated into the realm of scientific knowledge by a series of 53 experiments recently concluded by C. F. Langworthy and H. G. Barott of the Office of Home Economics, United States Department of Agriculture. A woman subject and a specially-constructed mechanical equipment were employed in negotiating the novel study, in which age, size, sex, and occupation, are influential factors in the variations of energy expenditure.

The principle of operation recognized that variations in the change of energy in the body are attended by corresponding variations in the heat output. In consequence, the expenditure of energy by the body was computed from measurements of the heat produced. The machine to which the woman under study submitted herself is technically described as a respiration calorimeter. The original design was modified, the change involving a reduction of the size of the apparatus in the interest of reliability in measuring the oxygen consumed by the subject. Also the mass of metal in the structural framework of the equipment was removed inasmuch as its presence introduced difficulties in obtaining accurate information relative to heat conditions of the chamber whenever any change was authorized in the activities of the woman subject. The respiration calorimeter, in brief, consists of a chamber 75 x 120 x 200 centimeters in dimensions, having air-tight walls. The machine is coupled to devices for maintaining a current of air through it from which the water vapor and carbon dioxide eliminated by the woman under examination can be removed. Equipment is likewise available for conveying away and measuring the quantity of heat produced within the chamber. The woman submitting herself to the observations remained in the caged-in outfit during the experimental period, resting in a swivel-chair or performing a specific household duty as the plans might prescribe. A comparison of the amount of energy transformed by the body during a specified time while at complete rest and while doing the allotted work was assumed to be the requirement of energy for the execution of the task at hand. Direct measurements of the heat produced by the body were determined.



Respiration calorimeter employed by the Office of Home Economics, Department of Agriculture, in determining the energy expenditure in performing household tasks

Since age and size are among the factors influencing variations in energy exacted in the performance of household tasks, it is permissible to reveal the age of the anonymous subject. She is 22 years old, thin and spare in build, 5 feet 4 inches tall, and weighs 110 pounds in uniform. Her weight was determined at the conclusion of each of the series of 53 experiments. Her attire consisted of a "middy blouse," a skirt of cotton, and underclothes light in weight. The experimental period was of two hours' duration, beginning at approximately the same time each day, an observance in the interest of uniform physiological conditions. The subject was deprived of breakfast, other than one cup of cocoa made uniformly of half a pint of cream, two teaspoonfuls of cocoa, and one teaspoonful of sugar, the hour of consumption being 7:30 in the morning. She entered the respiration calorimeter at 10:30, and measurements were begun between 11 and 11:30. While hemmed-in by the apparatus she submitted unerringly to the particular program of work, the tasks being performed to the beat of a metronome, an instrument which accurately counted the number of movements. Typical household responsibilities were included in the tests, the results of which are applicable in determining the strength exacted of the housewife in the execution of similar duties. Strange anomaly, it would seem, that clothes were washed in the absence of water. The presence of water, however, would have exercised a complicating effect on the water vapor and heat measurements in the calorimeter. Other experiments were conducted in orderly procedure.

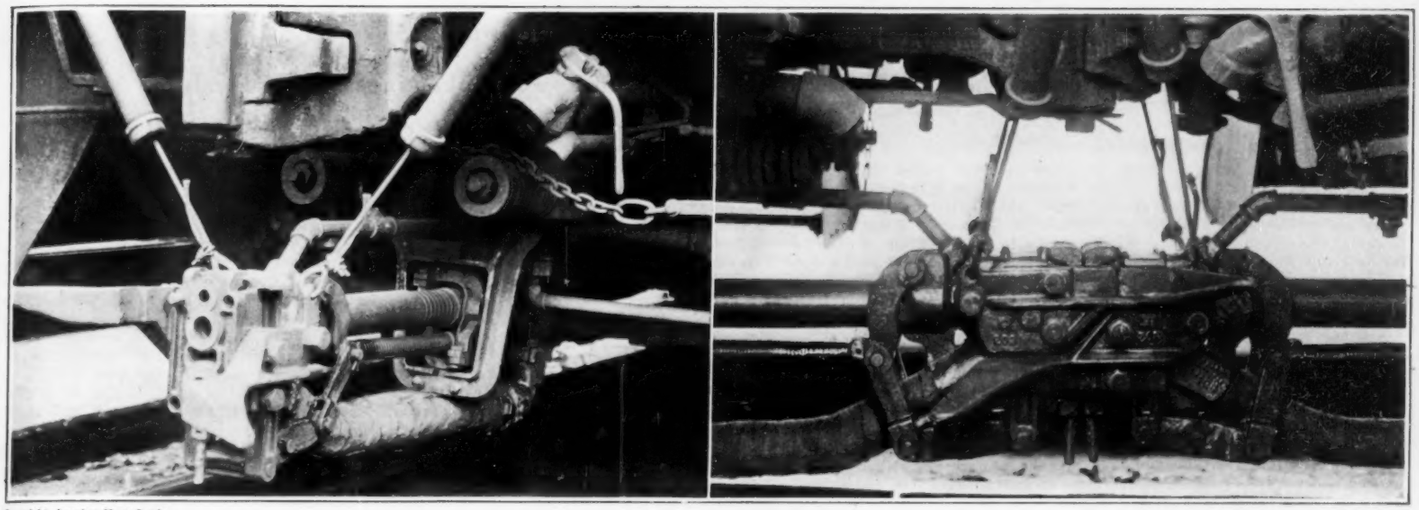
Instead of toiling and then resting, the subject took advantage of an opportunity and remained at ease in a comfortable swivel-chair at the outset of the experiments. Her inertia during four tests of two hours each is suggested by the statement that she hardly moved—quietness reigning supreme. The number of calories measured in each of the series of experiments was uniform, being 121.4 for the two-hour period or 60.7 calories expended each hour. The value of the heat output when the subject rested was that of forming a basis of comparison with results obtainable in the performance of work. The less arduous tasks of sewing, crocheting, knitting, darning, and embroidering involved an expenditure of 9 calories an hour in excess of the heat output when the woman subject relaxed unreservedly in a swivel-chair. Washing, sweeping, and scrubbing floors, represented as the more laborious activities of the household, exacted an increased energy requirement of 50 calories compared with the expenditure when the woman was at rest.

The inadvisability of submitting a baby to such an unseemly test to determine how much energy mother squandered in caring for children was an obstacle surmounted by use of a counterfeit infant. Dressing and undressing a full-sized model, comparable to a year-old infant, afforded data in this particular. A mother of a year-old boy, as Shakespeare would say, "mewling and pewking in the nurse's arms," will appreciate the fact that in this experimental laboratory of make-believe the model was dressed and undressed seven times within two hours. Its clothing consisted of a band (no sleeves), diaper, shirt with sleeves, two undershirts (no sleeves), dress, knitted sack, with sleeves, socks, booties, and bonnet. In terms of sweat of the brow, the fondling mother of this substitute baby expended 23.6 calories an hour for work alone. The figures are lower, undoubtedly, than the requirement in caring for a living child. The model weighed only 2 kilograms whereas a child of the size of the dummy would weigh 8 or 10 kilograms. Accepting the heat output of 23.6 calories an hour as approximately correct, the energy expenditure was twice as great as that entailed by sewing, similar to the requirements for dishwashing and ironing, and one-half that for washing clothes. Mothers, suffering from a storm-tossed house where boys romp at will, can subscribe to the sentiment of the Office of Home Economics that caring for children is a "moderately heavy household task." I suspect that the statement could be stretched and still remain within the bounds of truth.

Sweeping and washing floors, the bugaboo of housework, were conducted in the experimental laboratory with efforts aiming to duplicate those involved in actual practice. Sweeping was done on the bare floor, a long-handled broom being pushed forward, lifted, and moved back. Thirty-eight complete strokes were made each minute. In the absence of water, the floor-washing experiment involved the use of a dry cloth and empty pail. The woman, on her knees, administered 85 short rubs of the cloth on the floor in 50 seconds and wrung the rag in the pail for 10 seconds. Forty calories an hour were utilized for the work alone, indicating that this form of labor is four or five times greater than that of knitting and sewing. The 29 calories an hour for energy expenditure in floor washing is considered too low. The omission of water, thus relieving somewhat the burden of lifting and wringing the wet cloth, as well as the inexperience of the woman subject in this form of work, are circumstances for consideration in accepting the results of this experiment.

Dishwashing, a subject which constantly solicits inventive genius to devise a practical machine for the specific undertaking, was negotiated at tables of varying heights. One table was too low for comfort; another, excessive elevation was objectionable, while a third was gaged at a correct height. The low table was 65 centimeters from the floor, the high one was 100 centimeters, and the table whose height was suitably adjusted was 85 centimeters and the top of the pan 98 centimeters from the floor. The dishes, consisting of four plates, two bowls, two teacups, and two saucers, were placed in a pan, rubbed with a cloth, placed in draining pan and then wiped. Each dish rubbed ten times, turned, and given ten more rubs, in time with a measuring instrument, beating 130 times a minute. Ten beats were allowed to change dishes. The process was repeated twelve times per hour. With only 24.8 calories expended each hour, washing table dishes is classified as moderate toil, about midway be-

(*Continued on page 139*)



Copyright, American News Service

Two views of the Futrell automatic coupler which connects the steam, air, signal, electric light and telephone lines on trains without manual aid of any kind

Simplifying the Coupling of Trains

DURING the past twenty-five or thirty years the railroads of this country have been seeking a substitute for the old method of connecting by hand the rubber hose lines between railroad cars and coaches. These couplings are made after the cars are brought together on the draw-bar.

As a rule it is the duty of the brakemen to attend to these connections. At the risk to life and limb, they must crawl beneath the ends of the cars and fasten the hose. Accidents have often happened while the men performed this duty. Sometimes the men would slip on the wet or icy rails while the train started, and the net result would be that the victims would either be ground to death under the wheels, or they would have arms or legs cut off and be maimed for life. There are also cases on record where the railroad men have been crushed between the heads of the draw-bars while attending to the rubber hose connections.

The old system of coupling cars means also the waste of a lot of time, since a brakeman very often has to walk the entire length of a long freight train in order to couple up a single car.

Railroad men are familiar with the difficulty of preventing rubber hose from leaking. Leaks will occur at some time or other and even new hose is not always proof against a leak. This means that there is difficulty in maintaining sufficient steam for heating purposes in all the coaches of a passenger train. While the coaches nearest the locomotive are warm and comfortable, the rear coaches are cold. And there are kicks and complaints coming from the passengers. Furthermore, should the hose that operates the air brakes spring a leak, some disastrous results might follow. Perhaps a collision is imminent and the engineer may not be able to stop his train in time to prevent the loss of lives and property. The extra pumping a locomotive must do in order to maintain a sufficient air pressure against faulty joints necessitates the extra consumption of from 100 to 300 pounds of coal per hour. Here is wastage which runs into millions of dollars annually.

It is figured that at the present time there are in the United States about 2,500,000 passenger and freight cars and about 66,400 locomotives. If we figure the average life of hose at eight or nine months, and do not consider the losses due to careless treatment, with something like five or six million lengths in service, the annual renewals will number in the neighborhood of 9,000,000 pieces. At the present cost of hose this means an annual expenditure of close to $10,400,000. Obviously, there is room for improvement here, and several attempts have been made in the way of automatic car couplers, some of them being described in these columns in the past. We now have a new automatic coupler to consider.

Some years ago a railroad conductor by the name of Thomas J. Futrell, formerly of Seattle, Washington, but now of Streator, Illinois, saw the necessity of an automatic coupler to take the place of the old system of using rubber hose and connecting it by hand. Mr. Futrell has had nearly thirty years' experience in the railroad service, and from this one might draw the inference that he is familiar with the needs of the service. He determined to make a device that would be a time, money and life saver. After several years of labor, which meant many experiments, he finally attained the results he was after in the form of the automatic coupler shown in the accompanying illustrations at the top of the page.

(Continued on page 139)

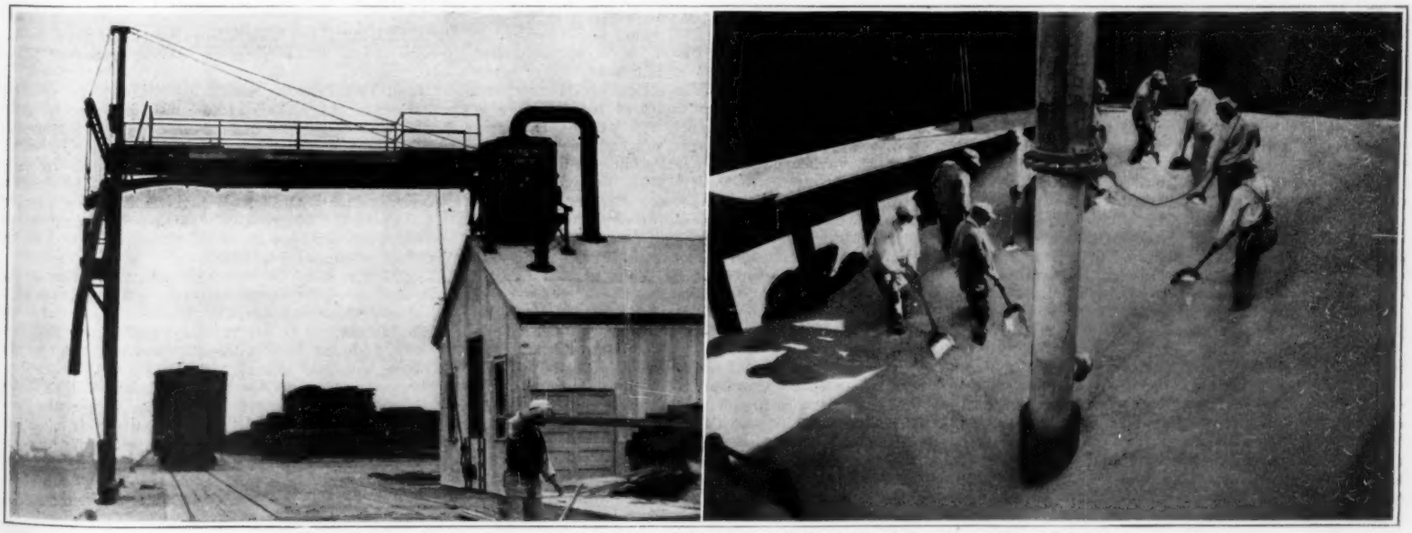
Sucking the Cargo Out of a Ship

MECHANICAL loading and unloading devices are an old story now, but the photographs herewith show a new angle of this interesting work. At Oakland, Cal., and at New Orleans, and doubtless at other points which have not come to our attention, pneumatic handling of bulk materials is now the order of the day, and these are taken out of the ship's hold or put in without being touched by hand, shovel or other instrument. The air pipe sucks the cargo out of the hold, carries it to the freight car, and packs it securely and tightly for its overland journey.

The machine consists in the first place of two pipes that go down into the interior of the ship. These run to the top of a small building on the pier in which are located the motors that supply the suction. These suction pipes lead the grain to the mouth of a second set of pipes which blow instead of suck, and through these it is forced out into the waiting car. So tightly does the blast force the grain into the space provided for it that the carrying capacity of the car is increased twenty per cent. Thirty tons of wheat per hour is the rated capacity of the Oakland installation.

At New Orleans the suction device is installed in connection with the public elevators, which we have already mentioned in these columns. It would appear from the photograph that this installation leaves something to be desired, in that it seems necessary for the grain to be assisted to the mouth of the pipe by men with shovels.

While the primary intent of the new system is the handling of grain, it is available for numerous other cargoes. At Oakland it has been used, among other things, for copra, which comes in fairly large pieces; so its range is wider than might appear. Doubtless it would be available for small sizes of coal.



The suction unloader as seen on the pier at Oakland, and in the hold of the ship at New Orleans

Winning Foreign Film Markets

How the American Motion Picture Industry Is Acquiring a Firm Footing in Other Lands

By O. R. Geyer

THERE is no greater industrial romance than the spectacular development of the film business in the United States in the last few years. Fewer than ten years ago critics were about evenly divided as to the future of the screen, which was just beginning to make its influence felt in an adolescent way in the amusement world. Today the film industry is serving 16,000 American theaters and is doing business which will aggregate $1,000,000,000 during the present year.

Another ten years will see the American films as firmly entrenched in world markets as today in America, and in the face of the most severe competition with British, French, Italian, German and Scandinavian producers and exporters. When this time comes the leading American companies will be serving 50,000 or more motion picture theaters scattered throughout every country in the world, and, unless all signs fail, will be entitled to a position in the class of industries doing an annual business of $2,000,000,000 or more.

An illustration of the progress made in this direction is to be found in the fact that the American film exporters have increased their business by more than 300 per cent in the last three years and, as yet, have made a very small dent in the foreign business awaiting development. An expression often used in recent years in connection with the development of the domestic business, "scratching the surface," now is applicable to the business being done in foreign fields. One of the leading producers and exporters of films increased its foreign business from $1,000,000 to approximately $5,000,000 in three years' time despite the restrictions placed upon commerce by the war. The present year will see another $2,000,000 or $3,000,000 in increased business for this one corporation alone. Add to this the enormous export business being done by other leading American concerns, and one may gain an idea of the great progress made by this infant American industry in its invasion of foreign fields.

Practically 95 per cent of this business has been developed in Great Britain, Western Europe and South America. The business now held in this portion of the globe is capable of vast expansion, for it is only in the last two years that American films have gained first place in these markets. More than three-fourths of the South American territory is awaiting development and it can truly be said that the markets of Western Europe have only been subjected to surface explorations.

The great potential markets of Africa, Central America, Australia, Central and Eastern Europe and Asia have yet to be opened on anything approaching the scale attained in other fields. Steps already have been taken for the exploitation of these fields, and the next few years will witness a surprising increase in the development of this youthful export industry. Because of the tremendous prestige gained by American pictures during the war, this country holds first place in the race for these markets.

China, with its 400,000,000 population and fewer than three score picture theaters; India, with its 300,000,000 and limited number of theaters; Africa, practically a virgin field; Russia, Germany, Siberia, Western Asia, Japan and Australia—all these offer unlimited opportunities for the expansion of the film export business, and it is to these countries that the leading American concerns are now beginning to turn their attention. In order to attain the highest possible development in these countries, many thousands of theaters must be built, and hundreds of millions of dollars will be required to finance these operations. This capital will come from the leading bankers of America and Europe who, within the last twelve months, have shown a disposition to embark heavily in such enterprises.

As one of the first steps in this program of development and expansion, some of the principal American companies are engaged in building and projecting large studio enterprises throughout the world. One American company has just completed a mammoth studio in London, in which British and American capital is interested. Production work has been begun and will be increased until it is conducted on a large scale. This company has also announced plans for the erection of a similar studio in Bombay, India, and within the next year or two will have studios in operation or building in France, Spain, the Scandinavian countries, Belgium, Switzerland, Poland, Italy, Czecho-Slovakia and possibly Germany.

Within a period of five years the building and operating of studios will have been extended to the principal South American countries, Russia, the Balkans, Egypt, South Africa, Asia Minor, China and Japan and such other territories as are found to be ripe for the inauguration of American producing activities. This activity is not confined wholly to one company, as other concerns have announced plans for the erection of studios in Great Britain, unanimously held to be the first stepping stone in this plan of world-wide development. Individual stars and producers are making arrangements to visit Europe for the making of occasional pictures, and these activities doubtless will be extended to other countries having a well-developed motion picture patronage.

In so far as possible local artists will be employed by each of these studios, although Americans will be placed in charge and American methods of production used throughout. American artists will be used for the production of individual pictures, or generally in those countries which have not developed the required dramatic talent. These studios will be utilized in developing mechanical and artistic experts as a concession to national sentiment. The stories of the foremost writers of these countries will be filmed on the locations actually described, which means an end to the day when foreign locations will be obtained in and around the Los Angeles studios. This is an innovation which will prove of great value in increasing the prestige of American-made pictures abroad, as inaccuracies in the details of costuming or locations find ready critics in all countries.

THE American motion picture industry has become infected with the new spirit of internationalism which has taken such firm root in the economic and industrial life of the country as the result of the seizure of war-time opportunities. Already the infant industry has definitely embarked upon a program of world-wide expansion and exploitation which is destined to eclipse the golden era now recognized as one of the great industrial romances of America. This is the story which Mr. Geyer, in close touch with the developments, has to tell us on this page.—THE EDITOR.

Strange as it may seem, a large amount of European capital is finding its way into these American ventures. It is quite well known that many millions already have been invested, and that tens of millions of additional capital will be ready as soon as more normal conditions are restored throughout the world. Leading financiers in Wall Street and other large American financial centers are heavily interested in the extension of producing and distributing activities abroad. It is estimated that several hundreds of millions of dollars will be required for the building of studios, erection of theaters and the providing of increased facilities for the foreign distribution of these pictures. It will be comparatively easy to obtain this vast sum, however, as capitalists have heard of the vast profits to be obtained from the production and distribution of high-grade pictures. It is also apparent that the industry has passed the promotion stage and is now firmly entrenched as a legitimate business enterprise.

An event of unusual importance in American film circles will be the opening of Germany and Central Europe to American pictures, an event whose exact schedule depends upon Germany's ability to begin the settling down process. This territory, which includes Germany, Austria, Hungary, Czecho-Slovakia, Jugo-Slovakia, Rumania, Poland, the Ukraine and Bulgaria, has been without American pictures for more than six years, and the masses of people are totally ignorant of the tremendous progress made in the film industry in the years they have been at war. Except for that portion of the Rhine territory occupied by Allied troops, no American films have been shown in Germany since 1914. A population of approximately 200,000,000 and 8000 motion picture theaters, offer the possibilities of rich rewards for the producers and distributers of high grade American pictures in Central Europe.

Arrangements are under way for the opening of the Asia Minor territory for the exploitation of American photoplays. This, too, is virgin territory, inasmuch as motion pictures were practically unknown prior to the latter years of the war. Bagdad, the Euphrates Valley, Jerusalem, and the valley of the Jordan were scarcely aware of the existence of the modern motion picture until Y. M. C. A. secretaries arrived in Asia Minor to provide entertainment for the British and Allied troops. Natives gained admission to some of these shows and immediately acquired the movie habit. Bagdad now has three theaters and will have many more within the next year or so.

The Arabs, Kurds, Turks and other nationalities in Western Asia derive a vast amount of pleasure from the modern film, provided it carries no features offensive to the teachings of the Koran. Grunts of delighted approval greet the deeds of daring of the cowboys and rough and ready men of the West as shown upon the screen. Kisses and the highly colored romanticism of the cheaper films are not enjoyed and are taboo. There are many large cities in this territory barren, or practically so, of motion picture houses. Teheran, the capital of Persia and a city of 70,000 has yet to experience the delight of its first film theater. The signing of a commercial treaty between Persia and Great Britain has opened the way for the exploitation of this field through enterprises controlled jointly by British and Americans, and it will not be many months before a highly prosperous motion-picture business has been organized in this vast territory.

As soon as Russia returns to peaceful pursuits American companies will be ready for the development of another great virgin territory. Except in a few favored localities no American pictures of a high grade character have been shown in Russia since the war began. A prominent company operating abroad extensively has completed arrangements for the opening of the Russian territory as soon as normal conditions are restored.

One obstacle in the path of the world-wide development of the motion picture is the woeful lack of theaters to accommodate the tens of millions who have acquired the liking for motion pictures. It is estimated that the portions of the globe in which the industry is now solidly entrenched could find immediate use for more than 20,000 large theaters today, and the need is constantly growing as the interest of the population in pictures increases. The war put a stop to theater building in all countries which engaged in the war and placed a damper upon such operations in neutral countries because of the lack of materials and labor. The return of peace has not improved conditions in this respect; the shortage of buildings for homes and industrial purposes is so serious that it will be several years before restrictions on amusement enterprises are removed.

Great Britain today has approximately 2800 theaters catering to the motion picture public. The industry there has urgent need of 3000 new theaters but cannot get them until the present drastic building rules are changed. The result is that every house is crowded to capacity, and enormous sums must be paid before a theater owner will surrender his business to another. Theaters built before the war now command prices 400 and 500 per cent above the pre-war levels, and are hard to obtain at any figure.

Another country in dire need of theaters, in so far as the motion picture interests are concerned, is France. There has been no theater building for six years, and it will be several years before new buildings can be undertaken on a large scale. Prior to the war France was not liberally supplied with theaters of this class, many cities possessing a population of 30,000 or more being without first class motion picture theaters. To provide for the ample accommodation of the millions of new "fans" France, it is estimated by competent authorities, should have several thousand modern theaters. The shortage is especially acute inasmuch as France is a large and important producer of motion pictures on its own account.

(*Continued on page 140*)

Soap Science

Recent Developments in the German Industry

By Arthur H. J. Keane

FOR the past 20 years or so formaldehyde soaps have been placed in the market which were intended to be used partly as antiseptic and partly as disinfectant soaps. The antiseptic kinds are soda soaps which, like ordinary grain soaps, are used for washing the hands; the disinfectant soaps are liquids which, when diluted mostly with warm water, are used not only for disinfecting the hands but also for disinfectant purposes in connection with sick beds, hospitals and the like. Solid formaldehyde soaps have, owing to their slight effect, not been largely introduced into practical use; liquid potash formalin soaps enjoy a wide-spread use. The latter are made mostly by treating fats with an oxy-acid radical, or from the oxy-acids themselves by saponification with potash lye and subsequent treatment with formaldehyde which latter possesses the capacity of dissolving the potash salt of the oxy-acids, probably forming double combinations at the same time. If the preparations thus derived are to be used for disinfecting the hands, then it is compulsory to dilute them in a suitable manner. This is effected preferably with the aid of warm water, numerous experiments having shown that formaldehyde, at a low temperature such as that of a room for instance, only exerts a very poor disinfective capacity. With the slightest rise in temperature, on the contrary, it is observed that a marked increase takes place in its disinfectant forces, closely approaching at 35 to 40 deg. Cent. that of a cresol solution of equal concentration; in fact it is even far superior to that spore-containing material.

As mentioned above, oxy-acid potash soaps possess the property of being dissolved by formalin; this, however, is not the case with the common sebacic acids or with unsaturated acids. Now if a mixture be used consisting of oxy-acid and ordinary sebacic acid, if this mixture be treated with potash-lye and formaldehyde be added, then the oxy-sebacic-acid potash will be dissolved, but the sebacic potash will be left practically undissolved. The result is that a solution of the formaldehyde-oxy-acid potash forms in the remaining texture of the sebacic-acid potash; this produces a transparent soft soap, such as can, otherwise, only be obtained by means of saponification with alcohol or sugar. The mixture of sebacic acid and oxy-sebacic acid is effected in such wise that only so much oxy-acid is used as can subsequently be brought into solution again by means of the formaldehyde. On the other hand no more formaldehyde is used than is equal to about ¾ to 1 per cent of the total quantity so that all irritant phenomena may be avoided when the soap is being used practically.

These soaps are now undergoing commercialization in Germany. They are intended to be used for direct contact with the skin and, in this case, the natural heat of the body takes the place of the warm water otherwise needed to dilute the liquid formaldehyde soap. Owing to its absolutely neutral composition the soap does not attack the skin, so that it can be allowed to remain upon the skin for hours at a time if necessary without the hands being prejudicially affected in the slightest degree. For practical use a modification of this basic soap is provided for, viz., by the addition of glycerin. From the observations made this glycerin must be added to the acids prior to saponification. It must be especially remarked that it is not possible to work glycerin into the soap by using triglycerides in place of sebacic acids; on the contrary the acids must always be taken as a working basis, the glycerin being added thereto. If it be desired to add other cosmetics, this must also be effected prior to saponification. Whether this new preparation will give full satisfaction as a disinfectant for the hands, especially for surgical requirements, remains to be seen; so far no practical tests in that direction have been carried out; however fair practical tests made in the laboratory have shown that its disinfectant action on bacteria is fully equal to that of formalin soap solutions of similar strength containing the same percentage of formaldehyde at temperatures of 30 to 35 deg. Cent. Hence the inference is that this soap should give satisfactory results in all cases where it is necessary to secure a rapid disinfection of the skin by rapid and simple means. The soap is rubbed upon the skin of the hands, or any other part of the body that has to be treated and, after being allowed to act for a few minutes, is washed off with cold or warm water. When the soap is applied to the skin it produces a pleasant cooling effect, and after removal leaves a certain dryness which is by no means unpleasant, especially in summer.

It is proposed to place this preparation upon the market in tubes so as to render its use as general and popular as possible, and with a view also to affording the public at large an opportunity of obtaining a pleasant and easily applicable toilet disinfectant. It should also be used after handling railway and other tickets, after journeys, in factories and offices containing bacterial dust and in all similar cases. Of course it can also be used in all such cases where formaldehyde has, hitherto, been medically prescribed, and more especially when it is desired to produce a hardening effect upon the skin.

Another interesting development is in the field of solid and molded soaps. It is already known how to mix various chemicals, including soaps, in the form of powder and then to press the mixture into pieces of certain shapes. It is also known to mix soaps with medical additions, the mixture being then allowed to dry, whereupon it is disintegrated and finally, by means of moderate pressure, formed into balls or tablets. It has, furthermore, already been proposed to prepare a mixture of liquid tallow grain-soap with water or silicious lime, this mixture being worked up in the usual way.

All these processes, however, did not prove advantageous in practical use, especially if it was desired to manufacture on a large scale highly filled, solid and molded soaps of a nature to comply with modern requirements. In this case the stamping process was not practicable because, on the one hand, it required too much power while, on the other hand, there was considerable wear and tear on the machinery and in addition to all this it is not every soap mixture that is applicable for this process. There were also other drawbacks, well known to those versed in this industry.

(*Continued on page 140*)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

The Recent Bombing Operations

To the Editor of the SCIENTIFIC AMERICAN:

After reading in the daily press that only two bombs out of eighty hit the "Iowa" during the recent aircraft maneuvers, it would appear to the layman that the problems attending such operations are no nearer solution that they were several years ago. Aviators are still unable to score but a small percentage of direct hits; and in the final analysis it is the direct hit that counts, the depth bomb and all other indirect-hit makeshifts to the contrary notwithstanding.

Air-bomb development has proceeded on the assumption that since the making of a direct hit was a matter of uncertainty, the greatest efficiency would be attained by using planes that carry a few large bombs; and as a consequence, if the bombs were big enough a near-hit would be just about as destructive as a direct hit. We hear much about the size of aerial bombs and the tonnage the big bombers carry, but nothing concerning any advancement in the all-important requirement of hitting the target. The reason for this is that the present method of air-bombing is so unscientific that to hit the bulls-eye is largely a matter of chance. Further improvement in the ability to hit with one big bomb is hardly possible.

But a larger percentage of direct hits *can be made*, nevertheless, *by employing methods better calculated to achieve such a result*. Let us consider these facts: The trapshooter uses a shotgun to hit flying targets, instead of a rifle, for the evident reason that the closely spaced pattern of the shotgun affords several hundred more chances of striking the target than the one bullet of the rifle. The aviator who endeavors to make a hit on even a stationary target when he and his bomb are moving at high speed is handicapped precisely as the rifleman is when he endeavors to break any considerable number of moving targets. The conditions are reversed, but the difficulties attending successful performance are the same. If the aviator's target is in motion, his task is still more difficult.

That is the way it looked to the writer back in the World War, so he began the development of a method and devices whereby the efficient pattern of the shotgun and the rapidity of fire of the machine gun are combined for the discharge of bombs from aircraft. The equipment was designed to handle any size bomb, and was adapted to operations over land or water. Competent engineers assured the writer that the device would function as designed; that a plane so equipped would lay an inescapable pattern of bombs over its objective and increase the chances of making a direct hit several hundred to one, as compared with the hit-or-miss, one-at-a-time method. The plans were taken to Washington and a special board of the Bureau of Ordnance in its report stated as follows: "Inasmuch as the tendency will unquestionably be in the direction of arming these planes with one or two large high-powered bombs, rather than with groups of smaller bombs, the necessity for your invention is believed to be non-existant." It is proper to point out here that the specifications said nothing about small bombs. The author of the board's letter drew that conclusion himself. The device was rejected, not because it lacked merit, but solely because the board was working along a certain line to the exclusion of every other.

Was there any "necessity" for such an invention? German submarines at that very time were taking heavy tolls of lives and shipping. They had even visited our Atlantic coast, and in sinking a vessel fired shells that lodged in our soil. While thus engaged, a German U-boat was attacked by a couple of our planes which dropped a number of bombs at her without making a hit. Yet this board said there was no "necessity" for an invention designed to destroy the submarine.

Hon. Josephus Daniels, in an article in the *Saturday Evening Post* of April 25, 1921, entitled "The Navy That Flies," quotes Frank J. Sprague, "an eminent member of the Naval Consulting Board," who in referring to air-bombing operations, says: "In one series of tests against a stationary ship there were 11 per cent. of direct hits." Mr. Daniels himself says in the same article: "The duty now uppermost with fighting fliers is how to hit the mark."

The operations against the "Iowa" netted 2½ per cent. of direct hits.

Is there any "necessity" now for a more efficient method of air-bombing? J. H. MURRELLE.

Sayre, Pa.

When Humpty-Dumpty Travels

To the Editor of the SCIENTIFIC AMERICAN:

I have read with much interest your article of April 2nd under the above title. This subject is always interesting, as we are continually striving to confine such damages to a minimum. The article itself is true to actual conditions, which we are encountering every day, to wit, eggs in second-hand cases or with flats and fillers not coming up to the standard and not properly stowed are continuing to produce breakage and result in claims, whereas the new standard case well packed and containing 3½ ounces excelsior cushions, top and bottom and between the first and second layers of each case shows little or no damage.

The reference on page 278 as to only $19 damage on a car that was in a wreck, on which an experienced freight estimater estimated the damage at $1000, he being of the opinion that the eggs were packed in standard cases with honeycomb fillers, refers, I believe, to the cup filler which is shown on the right-hand corner of page 265. It is our experience that this particular filler is by far the safest kind now in use and we hope it will be the authorized filler until such time as a better one is invented. The continual agitation with respect to breakage of eggs when cases and fillers do not protect the contents will have the result of greatly reducing the amount of breakage as compared with what it was a year or more back, so we will continue to make known to any delinquent shipper defects that should be remedied, as well as suggestions for improvement. W. J. EDWARDS.

Trunk Line Freight Inspection Bureau.

Doing Away with the Ice Man

How Electricity Has Brought a Cleaner, Drier and Colder Atmosphere to the Refrigerator

By Albert A. Hopkins

ONE of the constant problems of the average American household is ice. Ice is necessary to keep the icebox cool and to preserve the food placed therein. And ice means that the average American household must depend upon the tender mercies of the ice man, and that is precisely the root of the whole trouble.

The numerous attempts to emancipate the average American household from the ice man have taken the form of a number of practical refrigerating systems that operate by means of small electric motors and at a very low cost. Five of these systems may be considered as typical of these machines, and we are indebted to the New York Edison Company of New York City for the accompanying data and illustrations. Incidentally, it may be added that the New York Edison Company recently devoted their display space to an exhibition of domestic refrigerating devices with highly gratifying results, indicating that there is a steadily increasing desire on the part of the average American household to turn to some mechanical means of keeping the icebox cold.

One of the sulfur-dioxide refrigerating machines is externally a shaft carrying at one end a drum, at its middle another drum, and at its opposite end a pulley. Its appearance is practically that of a large dumbbell, and when it is mounted its end drum is in contact with water, brine or other liquid to be cooled, and the other drum is in a similar tank of flowing water to carry away the heat. Bearings hold it in place. There are no joints, valves, gages or stuffing boxes. This machine operates on the compression system, using sulfur dioxide as its refrigerating agent. The compressor—which it was possible to reduce to its simplest elements because of its peculiar situation—hangs loose on the shaft inside the condenser drum and is held in position by means of a counterweight. By no possibility can the machine operate to increase the pressure beyond the limit determined by the design of the counterweight. It is this feature of the machine that makes it practical for domestic refrigeration.

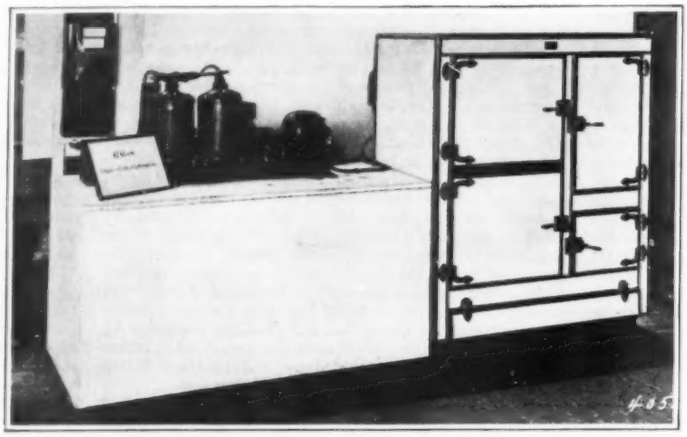
Another machine is sent out from the factory completely charged and ready to operate. The air is entirely exhausted and the charge of sulfur dioxide and a pure neutral oil is admitted, after which the machine is hermetically sealed. The working parts are thus constantly lubricated, not by the power-consuming churning action so often mistaken for good lubrication, but by a distribution of oil so that metal-to-metal contact practically cannot occur at any point. Pressure in condenser is constantly forcing oil between the working surfaces of the compressor.

Where electric current for power is obtainable at 6 cents per kilowatt hour, and condensing water at $1 per 1000 cubic feet, these machines will furnish refrigeration at from 16 to 22 cents per hundred pounds of refrigerating effect.

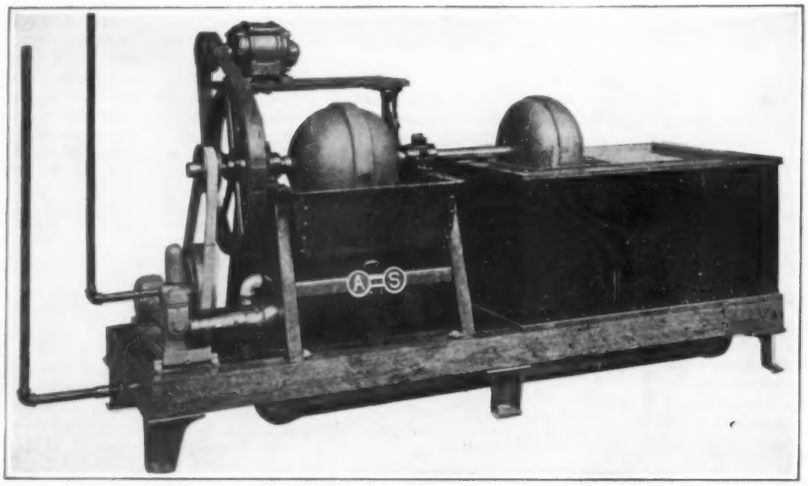
In another system of refrigeration ethyl chloride is used, which is nonpoisonous. The machine comprises the following essential parts: motor, compressor, condenser, separator, expansion valve and cooler. The cooler is placed directly in the refrigerator and filled with liquid ethyl chloride. A line from the top of the cooler leads to the suction side of the compressor. The discharge side of the compressor is connected through a line to the top of the condenser. A line leads from bottom of the condenser directly to the separator located at the bottom of the condenser. An automatic expansion valve is built into the head of the separator with a line leading from the same back to the bottom of the cooler. The refrigerating cycle is as follows: The compressor creates a vacuum in the cooler causing the liquid to boil, reducing the temperature of the same and taking up the heat from the refrigerator. This gas is drawn into the compressor and discharged at a slightly increased pressure into a condenser. The condenser shell contains a water coil which cools this gas while under compression, causing it to condense. The condensed liquid drops into the separator and passes to the expansion valve which automatically controls its flow back to the cooler, from which it is again boiled out, making the cycle complete and continuous while the machine is running. The lubricant is carried in the bottom of the separator from which a line leads to the compressor. The condenser pressure forces this lubricant to the compressor bearings from which it is led into the compressor and discharged into the condenser with the ethyl chloride gas. When this gas is condensed into a liquid, the lubricant, having a higher specific gravity than liquid ethyl chloride, drops to the bottom of the separator from where it is again forced to the compressor. The flow of the lubricant is also continuous when the machine is in operation.

Then we have a sulfur-dioxide machine in which the compressor and condenser chambers and motor are mounted on a single base which may be located in any convenient position near the refrigerator, or in an adjoining room or even in the basement. The brine tank, made to fit various standard refrigerators, is placed in the ice compartment and is connected to the machine by two seamless copper tubes and acts as a storage battery for the cold. The only moving parts of this machine are the two rotating gears of the compressor, which run submerged in a sealed chamber of oil and are directly connected with the one-quarter horsepower motor. The use of this simple compressor eliminates valves and reciprocating parts. The refrigerant—sulfur-dioxide, a harmless gas—is also sealed in the system. When cooled under moderate pressure it becomes a liquid and as such is supplied to the expansion coil of the brine tank where it expands into a gaseous form, extracting the heat from the refrigerator. When it has absorbed its quota of heat, the compressor removes it from the expansion coil and delivers it to the condenser chamber where the water, circulating through the cooling coils, absorbs the heat and the gas again becomes a liquid and is ready to start on another journey. This simple process is carried on in continuous cycles. The machine is automatically operated and can be set to maintain any suitable degree of cold in the refrigerator, the machine starting and stopping at the predetermined temperatures. The household machine is capable of cooling well insulated refrigerator space of from 25 to 40 cubic feet.

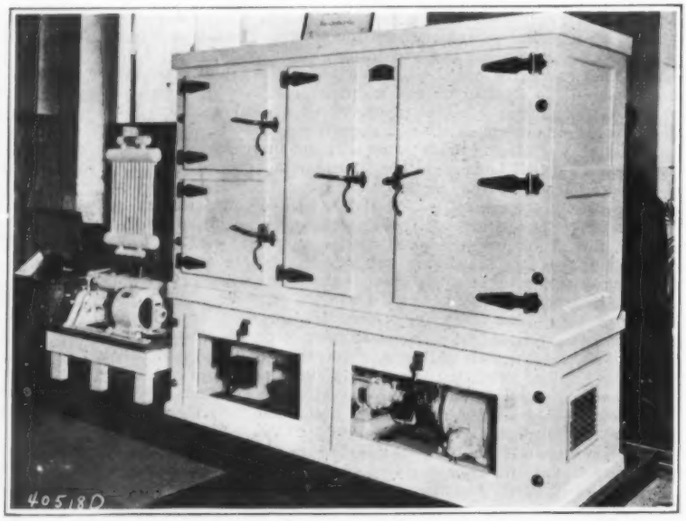
Another sulfur-dioxide machine, which we do not illustrate, operates on the compression system under low pressure and has an expansion side and a



A sulfur-dioxide machine of compact dimensions which makes a feature of its easy attachability to various standard refrigerators and its thermostatic control



An ice machine that employs sulfur-dioxide, and that boasts a counterweight which prevents the pressure from going too high

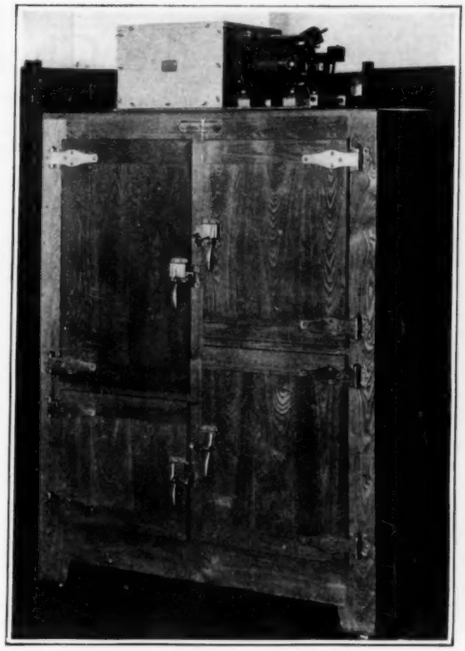


External view of the refrigerating system which makes use of ethyl chloride

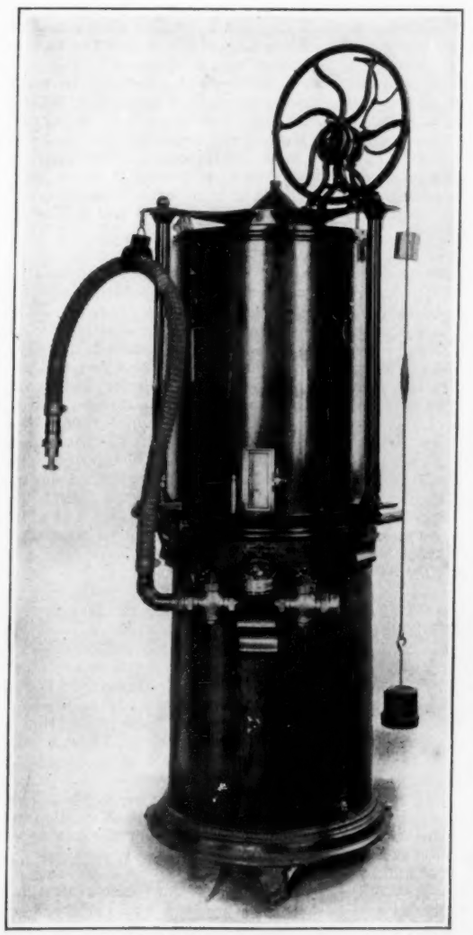
compression side. The expansion side consists of a copper tank filled with salt brine, in which the expansion coils are located. This tank is put in the ice chamber of the refrigerator. On the top of the tank is an expansion valve of the diaphragm type, and the refrigerant which is sulfur dioxide (SO_2) is expanded through the coils in this tank under a normal working pressure of 6 to 8 pounds when the machine is idle but about 3 pounds or less when running. After passing through the coils in the brine tank, the gas goes direct to the compressor, which is of the double cylinder, S. A. type and air cooled. It is then compressed and discharged into the condenser, which is a rectangular coil of ½-inch copper tubing, immediately surrounding the compressor and motor, all being mounted on a substantial base. The condensation of the hot gas in this coil is accomplished by air cooling, no water being required. The normal condensing pressure is 60 pounds but may run to 80 pounds under unduly warm atmospheric conditions. At the bottom of the condenser coil, liquid is carried off through a ¼-inch copper tube to the expansion valve, so as to give no more liquid than necessary to accomplish proper refrigeration. On this system only 3 valves are used, a suction on front of compressor, a discharge on top of compressor, and one at end of condenser coil. The entire system is tested at 350 pounds' pressure, therefore the chances of leakage are very slight. The compressor is operated by a ¼-horsepower motor, belt connected, and supplied with an idler. The motor is controlled by a thermostat situated on top of the brine tank. This thermostat is of the syphon type, and when the temperature in the refrigerator reaches too warm a point, a switch is thrown and the motor and machine run until the box is cooled down, when it automatically cuts off. The running of the machine is therefore intermittent instead of constant, and under normal conditions will cover a period of eight to ten hours out of the twenty-four.

The outfit illustrated on this page consists of a refrigerating machine of 150 pounds ice-melting effect per day mounted on a heavily insulated box 5 feet high, 4 feet wide and 2 feet deep. A brine tank containing about 100 pounds of brine is located in the upper left-hand compartment of the refrigerator. In the brine is immersed a coil of pipe containing several pounds of the liquid refrigerant—ethyl chloride. When the temperature of the box rises to 44 degrees a thermostat closes the circuit-breaker on the electric motor, which is directly connected to the compressor. The compressor removes the vaporized refrigerant from the immersed coil thus causing a slight reduction in pressure and consequent further evaporation of the liquid and absorption of heat from the surrounding brine delivering the vapor, heated by compression to about 150 degrees, to the condenser coil. Here it is cooled by the circulation of air at room temperature. This cooling causes the vapor to liquefy, after which it collects in the chamber of the float-controlled expansion valve, from which it is intermittently returned to the vaporizing coil in the brine tank, when sufficient liquid has condensed to lift the float. The cycle of heat absorption, vaporization, compression, cooling and liquefaction is repeated until the box temperature is lowered to 42 degrees, when the thermostat again operates, opening the circuit breaker and stopping the compressor. The front of the brine tank is recessed so as to form a small chamber or "oven" which is provided with six pans and removable cubing grids for making ice for table use, or frozen deserts. This gives an ice-making capacity of 16 pounds or 72 2-inch cubes. The compressor is of the rotary valveless type operating at 1150 revolutions per minute and supplied with a pressure feed lubricating system, and is mounted directly on the frame of a ¼-horsepower electric motor. On the motor shaft between the compressor and motor is mounted a multivane blower which induces two air currents, one over the compressor, and the condenser coils accomplishing the liquefaction of the refrigerant; the other, over and through the motor, enabling it to operate at full load if necessary without any possibility of overheating. The air is then discharged through the top of the ornamental cover which conceals the refrigerating machinery. The machine will operate about eight hours a day with a power consumption of 2¼ kilowatt-hours.

Having now described these types which are safe for domestic use, it may be said in passing that we are not discriminating against the ammonia machines but we feel that the types shown will prove satisfactory for small installations while the ammonia system is of course more economical for large plants. We need hardly refer to the enormous efficiency of refrigeration by electricity in the household for though the initial expense seems high and the cost of operation is also high—if current is dear, yet the saving in not having to clean out the ice compartment, not having to bother with the water caused by meltage and the assurance that the ice is pure is of enormous value. The time will come when those who build houses will reckon with their refrigeration problem as they do now with their plumbing, lighting, or heating or heating plants.



Another refrigerating machine which uses ethyl-chloride



Small gas tank which serves the purpose of checking up the accuracy of domestic gas meters

Is the Gas Meter Accurate?

THE consumer finds that the periodical bills presented by the gas company for gas used for lighting and cooking purposes vary widely from month to month. It may be that the demands of the consumer are responsible for the fluctuations. Not infrequently, however, a faulty or seemingly gluttonous meter fails to record the consuming flow unerringly. Even the company's reader of meters may unjustly be criticized for the misgivings of an erring meter, the employee of the corporation being charged with hasty conclusions. Anyway, widespread complaints question the accuracy of the consumer's meter, and this Government of ours being one of checks and balances, a mechanism has come into use for keeping tab on meters.

These meters resolve themselves into two types—the automatic and the standard. The latter, as shown in the accompanying photograph, is most suitable and more generally used for inspection work. Some states make it compulsory for gas companies to own a prover, and the National Bureau of Standards subscribes to the opinion that any company owning as many as 200 or 300 meters is justified in acquiring a 2-foot or larger prover. Otherwise, it is suggested that a small company have its meters tested by a substantial company in a neighboring town. The instrument is designed for testing consumers' meters on a commercial scale: the Bureau of Standards explaining, "The testing of meters in place on customers' premises has never been successful for regular work."

The tank of the 5-foot prover, as illustrated, is made ring-shaped so that its water-consuming capacity will be kept at a minimum. Such a specification enables the prover to assume room temperature more rapidly, permits of quick filling and emptying, and deprives the outfit of some of its cumbersomeness. The annular tank, however, has its shortcomings, namely, difficult to clean and repaint. The bell is made of copper, considered to be economical and to offer more resistance to corrosion. A copper or brass bell retains its new appearance when well polished and by oiling it water will not adhere to its surface. The prover is elevated from the floor by legs with screw feet, which arrangement facilitates the leveling of the apparatus for testing. Not unlike the object to be tested, the prover is not infallible. Hence these cautious injunctions: The prover must be mathematically correct, perfectly level, duly counterpoised, and adjusted so as to give uniform pressure from top to bottom during the movement of the bell.

The scale can be screwed to the bell and pointer on the tank or it may be placed on one of the pillars which carry the bell support, the pointer being located at the top of the bell. The air thermometer is mounted half way up one of the prover pillars, sufficiently removed from the operator that his presence will not influence its readings. Preferably, the water thermometer is so mounted that, with its bulk in the water of the prover tank, it may be read without being touched by the operator. The smallest divisions on the thermometer should represent a temperature difference of not more than one degree Fahrenheit. Both thermometers are tested to establish their accuracy.

Provers are manufactured in 2, 5, 10 and 20 cubic-foot sizes. The Bureau of Standards suggests a convenient set-up for routine meter testing: Two provers are satisfactorily located with a bench between them for a single operator, suitable connections to prover and to vent being provided. From 60 to 80 meters can be examined in a day by one man. Either gas or air can be used in meter proving; many companies, however, favor the employment of gas, claiming that air dries out the diaphragms of the meters. Testing is negotiated under a pressure of 1.5 water, where the latter is used in proving. Meters should stand near the prover five or six hours before testing. The temperature of the room and the water in the prover should not vary more than one degree Fahrenheit. Hose coupling of suitable size is selected for connecting the meter with the prover.

Once having closed the connection of prover to the meter, the former is filled with air. The outlet is connected to the vent, allowing one-half to one or more cubic feet of air to pass through the meter to see that it is functioning properly. The tightness of the connections and of the meter are tested; then air or gas is passed through the meter to bring the test dial hand exactly to one of the division lines of the dial. Adjust the prover by raising above zero mark, allowing air to escape until it is exactly at zero. Open connection to meter and permit air to pass till one revolution of test hand has occurred, which requires 2, 5 or 10 cubic feet of ar, dependent upon size of the meter. Forthwith record the reading of the prover to the nearest one-hundredth cubic foot, and from this calculate the error of the meter.

The Service of the Chemist

A Department Devoted to Progress in the Field of Applied Chemistry

Conducted by H. E. HOWE, Chemical Engineer

Aluminum Wings

AMONG the things which could not be done is to be listed the preparation of aluminum alloy sheets of sufficient strength and thinness to make them useful for airplane wings. While airplanes with metallic wings have not as yet displaced the fabric wing type; still a number of very successful flights have been made with metallic wing models in which the aluminum alloy is used in place of the silk or linen or cotton fabric heretofore employed exclusively. These metal sheets are rolled down to a thinness of 0.0025 inch, which is a little more than one-third the thickness of the safety razor blade, which is 0.006 inch. This thin aluminum alloy has a tensile strength of 60,000 pounds per square inch and is indeed a remarkable product.

Glue Stains

THE vegetable and casein glues, which are extensively used at present in preparing laminated and veneer woods, particularly from oak, maple, cherry, elm, ash, birch, and beech, are prepared with the aid of caustic soda. Some of these glues stain the wood more than others, those containing the most alkali being the most injurious. The staining is believed to be due to the action of the alkali in the glue on the constituents of the wood, particularly the tannin, from which an ink-like substance is formed. No way has been found as yet to prevent this chemical reaction; but in technical note No. 146, the Forest Products Laboratory indicates methods whereby these stains may be reduced to the minimum. The greatest trouble comes from the penetration of the glue through thin face veneers, especially if the veneer is less than one-twentieth of an inch thick. Since the thinner glues show a greater penetration than the thicker ones it is obvious that where thin veneers are used it would be well to use the more viscous glues or to use fillers in the glue when staining is feared. It has been found that if drying after glueing is accomplished promptly the solution has difficulty in reaching the surface. If some flat object is placed between panels in the press, staining is decreased.

The casein and vegetable glue stains can be almost completely removed by sponging the stained surface with a solution prepared by dissolving one ounce of oxalic acid crystals in about twelve ounces of water. The more stubborn stains should be moistened first with a sodium sulfite solution of the same strength as the oxalic acid solution and then follow this treatment with the acid.

Synthetic Alcohol

DURING the year Calvert, in England, has developed a process for the direct synthetic production of alcohol from water gas and producer gas by catalysis. It is claimed that ethyl alcohol of 99.2 per cent purity has been obtained from ordinary water gas with a yield of 90 per cent.

Already research is in progress looking to the synthesis of methanol, which is almost as important as ethyl alcohol, being the principal raw material in the manufacture of formalin, although the quantity used annually is not so great as for the other alcohol with which it is often confused by the layman. With ethyl alcohol now being made successfully from a variety of raw materials, as well as synthetically, there ought to be no difficulty in meeting the world's demands at a reasonable price. In Brazil they are finding it possible to operate trains on the sugar plantations with alcohol produced from the molasses tailings, this alcohol being produced for less than twenty cents per gallon. The distillation of hard wood continues to be our sole source for methanol, and with the rate at which our hard wood is being used we should already have increased interest in the possibility of developing laboratory methods for the production of this important solvent.

Colorado Shale Oils

PROFESSOR A. J. FRANKS, of the Colorado School of Mines, reports the results of studies of Colorado shale oils in the July 13th issue of *Chemical and Metallurgical Engineering*.

"Colorado shale oils and their fractions contain much nitrogen which seems to be present as basic compounds, and complex, unstable, unsaturated substances of high specific gravity and molecular weight. The distribution of nitrogen is similar for each of the three oils studied, the heavier fractions containing by far the larger amounts. Cracking of the latter during distillation effects a great loss of nitrogen and masks its true distribution. The total loss observed was about 40 per cent of the nitrogen occurring in the crude oil showing that one of the classes of nitrogenous substances is very unstable."

The author found sulfur to be less in the light and heavy oils and greater in the middle oils. The amount of sulfur in the heavy oils was reduced by the cracking process, showing that at least part of the compounds which decomposed contained sulfur. About one-third of the sulfur in the crude oil was lost during the distillation process; but in spite of this the distillate contains about the same percentage as the original oil.

From this it would appear that the saturated oils formed by cracking are produced from unsaturated compounds containing sulfur and nitrogen which are easily decomposed during destructive distillation. The author proposes to carry on the work on the changes wrought by successive distillations of shale oils.

Hard Soap

A PATENT has been granted for the use of sodium acetate and sodium lactate as a hardening agent in soap making. The patent is No. 1377843, and it is claimed that these reagents impart to the soap greater detergent qualities and firmness without the deleterious qualities to be found in strongly alkaline soaps. The addition of sodium acetate is accomplished in the manufacture of transparent soaps by incorporating sufficient acetic acid to neutralize the excess alkali. The sodium acetate thus formed permits a neutral soap for which the best grades of stock are required, and in the case of transparent soap, alcohol must be added. Increased hardness is obtained by finally adding one or two per cent of sodium acetate or lactate, the lactate being superior in promoting transparency.

It is stated that a transparent soap may be made along these lines from a mixture of 50 per cent tallow, 30 per cent cocoanut oil, and 20 per cent castor oil. Excess water, which ordinarily would prevent the hardening of the soap, does not interfere, as the addition of a small amount of acetate will cause it to set. The resulting soap will be of a transparent character and retain its content of glycerin and the added alcohol.

Atmospheric Corrosion

THE Committee on Corrosion of Iron and Steel of the American Society for Testing Materials reported that tests which have been in progress for five years in the Pittsburgh district on uncoated metal sheets are nearing completion and have now reached the point where the committee definitely concludes that "copper-bearing metal shows marked superiority in rust-resisting properties as compared to non-copper-bearing metal of substantially the same general composition from which superiority we may truly anticipate a marked increase in the service life of copper-bearing metals under atmospheric exposure of uncoated sheets." Other corrosion tests are being conducted in different parts of the country, and before very long a final report may be expected in which results of importance will be stated.

Anthraquinone

ANTHRAQUINONE is the basis of the largest class of vat colors for which we have been clamoring and in the production of which our dye manufacturers have been somewhat deficient. Anthraquinone is usually derived from anthracene. The difficulty in obtaining adequate supplies of anthracene has been due to the fact that the usual methods for separating it from coal tar left the pitch residue so hard that it could not be sold for American uses. Such pitch does find a market abroad, particularly for the briqueting of coal dust and coke breeze; but there is no great demand for such pitch for this purpose in the United States. Unless the pitch can be readily sold, the anthracene produced by the old process becomes so expensive that the anthraquinone, and the vat dyes made from it, become too costly to be used. The process heretofore has been to dissolve anthracene in acetic acid and oxidize the mixture with bichromate.

According to a note in the June issue of the *Journal of Industrial and Engineering Chemistry* an electrolytic process known as the Thatcher Process has been developed, being an electrochemical one depending upon the use of a special type of cell. It is also claimed that the Thatcher method for removing the anthracene from the tar leaves a pitch which is marketable in America. At present a thousand pounds of anthraquinone are being produced per day, and the plant runs continuously. It is thought that the production of a thousand pounds per day will assure an ample supply for the next few months as, at present, consumption is lower than normal. About three million pounds of anthraquinone is required for the estimated annual consumption of vat dyes in America, although it is to be expected that with the manufacture of vat dyes here the demand for anthraquinone will increase. There has never been any question as to the presence of sufficient anthracene in American coal tars, and if the Thatcher Process accomplishes what is claimed for it a great advantage to the American dyestuff industry will have been gained.

Research in the Lime Industry

IN his report before the National Lime Association meeting in June, President Charles Warner, in his report, made the following statements relative to research:

Take, for instance, the problem of developing the best type of quick-hardening lime plaster and mortar. This question is of great importance to the construction field. It has been attempted more or less superficially and spasmodically by many manufacturers as well as in some of the past efforts of your association staff.

Under past efforts the problem has not been suitably solved for the broad welfare of the industry. It has not been until within the fiscal year just closing that we have been able to lay a broad plan for its study, utilizing fellowships at the Bureau of Standards and elsewhere for taking hold of particular phases of the problem with the intention of gradually bringing all these lines together into a broad basic report that will throw the fullest light on the proposition.

To get at this problem there are four major lines of study and research that have to be undertaken, and each of these four major divisions fans out into numerous sub-studies and minor researches:

First—The effect of burning, grinding and hydration in various combinations and in conjunction with other ingredients to locate any refinement in manufacturing processes that may stimulate hardening in the finished product.

Second—The study of any hardening materials which of and by themselves and upon addition to lime will harden the mixed product.

Third—Carbon dioxide is the ingredient first naturally employed in the normal hardening of plasters and mortars, but, limited by the slow effect and small quantity of this gas found in normal atmosphere, it becomes necessary to determine all materials, such as charcoal, which might absorb carbonic gas in quantity yet hold it so loosely that upon admixture with lime and water a quick release of the carbonic gas would produce rapid carbonization and hardening throughout the mass.

Fourth—It is within the bounds of possibility that we can locate a chemical compound which upon addition in small quantities to lime will immediately establish in the lime an entirely new set of hardening characteristics and solve our problem in that fashion.

Proofing Fabrics

FABRICS may be proofed against soiling or staining by applying a solution of cellulose nitrate or acetate to the surface. The penetration of the solution into the fabric is prevented by impregnating it with some such volatile liquid as benzine before applying the cellulose solution.

A patent has been granted on a process of using insoluble alginates formed on fabrics by padding them with a soluble alginate and then passing them through a bath of zinc sulfate or similar heavy metal salt. The alginate separates in a colloidal form, giving a water proof finish which is said to resist a boiling neutral dye bath.

Balloon fabrics are rendered more impermeable to gases by the use of a mixture of rubber and cellulose acetate. This is applied in the form of a colloidal mixture in such solvents as tetrachlorethane.

Painting with Metal Spray

(*Continued from page 128*)

particularly serviceable when outdoor structures, large castings, etc., have to be treated where they are located for the nonce or permanently. The Schoop interests have devised a "Metallisator" of moderate dimensions which permits the rapid galvanizing, tinning, leading, etc., of quantities of small metal articles. The latter are rotated in a tumbling barrel or drum, and attached to the supporting shaft is a spraying pistol which oscillates so that it will scatter the molten metal in every direction. By the aid of this machine numerous products can be handled quickly and cheaply. In zinc coating by this means the protective metal penetrates into the pores and interstices of the supporting mass and produces a uniform film which is so nearly permanent that it will give without breaking to hammer blows and repeated bending stresses.

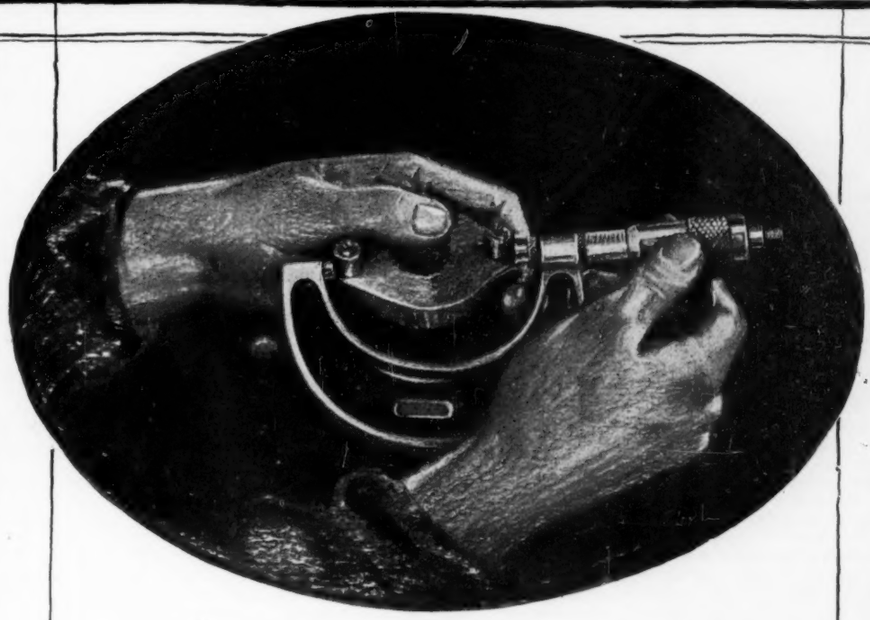
The Schoop process has been employed beneficially in leading the iron buckets of Pelton wheels in hydroelectric plants abroad. Ordinarily, these buckets, when exposed to on-coming sand and gravel, are rather rapidly worn away. The lead coating arrests this destructive action, for the impacting abrasives actually tend to anchor the lead more securely to the underlying iron, while the grit or gravel exerts but a very moderate erosive effect upon the protecting film. Chemical vessels of iron have been made resistant to corrosion by surfacing them, according to the nature of the chemicals to be handled, with lead or aluminum. This expedient has insured longer life and brought about substantial economies.

As might be expected the main use of the metal-spraying process is for zincing. This system has gained extensive recognition in Switzerland, France, Italy, and Germany. Two years ago the Swiss Government adopted the Schoop method of galvanizing for the state railways and now employs it widely in the iron and steel shops and in the locomotive and car works at Neuhausen and Schlieren. The transmission towers and spreaders of the St. Gotthard electrified line, two railway bridges, and the underbodies of 20,000 cars have been zinc coated in this way. Rain falling upon laden coke and coal carriers absorbs some of the sulfur content of the fuels, and this water promotes deterioration of any iron or steel it may reach. A zinc film is much superior to paint and more lasting as a safeguard against this harmful action. The Swiss have also found it desirable to supplement the zinc coating of their bridges with one of sprayed lead wherever the steel or iron fabric lies in the sweep of gases from locomotive smokestacks.

According to the latest reports, the electro-pistol is said to be superior to the gas pistol both in a technical and in an industrial sense. The zinc coating ranges in thickness from .003 to .005 millimeters and a capable operative can galvanize a square meter of surface in the course of from 6 to 7 minutes. The potentialities of the process in the electro-technical and electro-chemical fields are too numerous to mention. A single example, however, will serve as a hint. It has been established that a substantial gain can be made in the direction of increased efficiency and greater operative safety by partly coating high-tension porcelain insulators with a film of copper deposited by spraying. The municipal electric plant of Stockholm has placed in one transmission line as many as 25,000 of these metal-coated insulators; and a porcelain factory at Hermsdorf is using a battery of Schoop pistols right along in the manufacture of insulators. The copper coating gives excellent contact surfaces, and owing thereto transmission resistances are reduced proportionately.

Theoretical objection to the Schoop system has been advanced by some critics on

(*Continued on page 139*)



ACCURACY—

—the accuracy that has been recognized by two generations of machinists as an inherent quality of every Starrett Tool—is the first requirement for working metal within close limits.

2100 Starrett Tools are described and illustrated in the new Starrett Catalog No. 22"B" Copy sent free on request.

THE L. S. STARRETT COMPANY

The World's Greatest Toolmakers
Manufacturers of Hack Saws Unexcelled
ATHOL, MASS.

Starrett Tools

42-216

Starrett Combination Squares Graduated with Metric Measure Now Available

Machinists and carpenters working in metric measure will be interested to know that Starrett Combination Squares are now available with the blades graduated in millimeters and one-half millimeters. These squares are similar in all other respects to the well-known line of Starrett Combination Squares No. 23, listed on page 62 of the new Starrett Catalog No. 22. The metric squares are listed as No. 23 M and are made in three sizes determined by the length of blade, the latter being, respectively, 15 cm., 20 cm., and 30 cm. All sizes are sent equipped with Starrett Center Head, in addition to the regular frame, unless otherwise ordered. When ordered without center head, a suitable reduction in price is made. Prices of all sizes with and without center head are given in Starrett Catalog, No. 22 "B".

Improved Universal Bevel Protractor Added to Starrett Line

To all users of protractors, the Starrett line of these instruments has long been favorably known for their wide utility, accuracy, and convenience. In the Starrett Universal Bevel Protractor No. 359, recently added to the Starrett line and listed among the new Starrett tools in the latest Starrett Catalog No. 22, this utility and convenience has been still further developed.

Instead of the disc being graduated in degrees from 0 to 90 each way, the new protractor has a dial graduated to degrees throughout the entire circle. Encased in the body of the instrument is a new positive method of making fine vernier adjustments. All adjustments are so arranged as to permit of control from the center of the front side of the tool, a feature largely contributing to the superior convenience of this protractor in service. This arrangement consists of three nuts centering upon each other, the lower nut locking the dial in its rotative path, the middle nut at a slight downward pressure engaging the fine adjusting device, while the upper nut locks the blade at any point in its length. An acute angle attachment is also furnished by means of which small angles can readily be obtained.

Starrett Universal Bevel Protractors may be had with 7 inch blade or 12 inch blade, or both, with or without leather cases. The protractor may also be had without the acute angle attachment, at a suitable reduction in price.

The Motor-Driven Commercial Vehicle

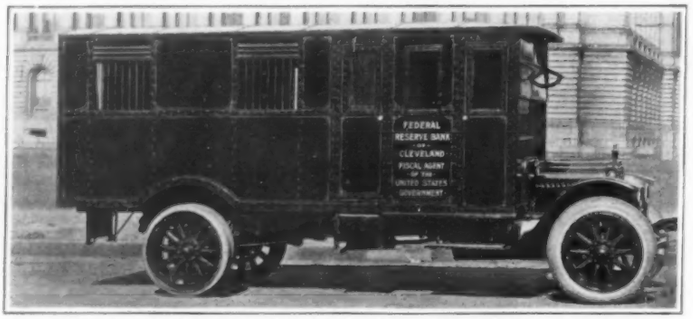
Conducted by MAJOR VICTOR W. PAGÉ, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

Armored Truck to Foil Bandit Payroll Gangs

SPORADIC cases of lives lost and payrolls stolen in the ambush by bandits of armed, but nevertheless practically defenseless, messengers in the number of cities during recent weeks, have kindled a new interest in the lead taken in New York, Boston, Chicago, Philadelphia, Cincinnati, and Cleveland by banks, public utilities and other companies having constant need to transfer money and other valuables. The lead they have taken lies in the direction of greater security and enhanced service, as well as less loss of life and money, in the transportation of large sums through the thoroughfares of congested cities. Seeing an opportunity to render real service to industrial concerns, merchants and others by making a specialty of offering them safety and service in the transfer of payrolls and money, while protecting their own transactions by means of the same conveyance, more and more banks are purchasing armored motor trucks.

Two large trucks of the type shown in the accompanying illustration, with armored bodies, transfer thousands of dollars daily for two big banks in downtown New York. One truck—a 2-ton unit—carries a body of quarter-inch steel. In addition to the driver, two guards generally man the truck on its trips. The guards, heavily armed, ride on the inside. The keys to the only door (in the side of the body) are held in the branch banks or in the possession of the guards riding inside the truck. In no case can the driver open the door. In the event of the truck being fired upon, the steel walls of the body are of sufficient strength to flatten ordinary lead bullets, while from their protected position in the interior of the "fortress," the guards can return the fire of bandits through "portholes" arranged for such an emergency.



Armored motor truck now employed in various cities for the transportation of large sums of money and valuables

A Step Ahead In Motor Bus Development

MOTOR busses as a means of transportation are growing daily in popularity. The motor bus of the past has not been perfect but its virtues have far outweighed its shortcomings. Passenger transportation by motor bus is rapidly leaving the realm of the experimental and entering into a period of sound development in its legitimate sphere. This development has been of two kinds: First, better management of bus lines; second, improvement in the vehicle itself. Motor bus service properly organized and operated so as to supplement existing transportation systems, affords the only practicable means of handling increased traffic in cities of moderate size, and of satisfying the demands of the public for better service without extensive and prohibitive outlay for new plants, trackage and equipment. As feeders for existing transit systems, as rush hour carriers and as successors of unprofitable branch lines of the present trolley systems, they have a field of usefulness which all transportation experts recognize.

The type of "jitney bus" in use today is, however, as far from perfection as the automobile of fifteen years ago was from the motor car of today. The design and construction of the bodies are crude, the seating arrangements are unsatisfactory because they permit distasteful and unsafe crowding of the passengers and the tendency to overload has caused the expense of upkeep to equal, if not to exceed the return. Realizing that the future of the motor bus depends on the development of the vehicle fully as much as it does on improvement in the method of applying it to transportation problems, a prominent New York truck manufacturer has designed a new type of bus which is said to eliminate the undesirable features of many of those now in use. The body is constructed of steel, including underframe, upright, side panels and roof. Seats are either of cane or leatherette, are placed crosswise; interior fittings have been made to withstand severe usage; traveling conveniences such as seat upholstery and interior lighting have been greatly improved; ventilators are installed, curtains for the windows are furnished; illuminated revolving signs indicate destination; non-rattling windows and exhaust heating for cold weather have been provided; and the body has been placed on a chassis of such power and dependability as to insure regular operation under the most severe conditions. Although smaller and lighter than the usual trolley car this bus with its large pneumatic tires gives greater comfort and ease of riding than is obtainable in the trolley. In addition it has the speed and flexibility of operation which has been responsible for the ever-growing popularity of motor-bus transportation.

Laminated Wood Disk Wheels

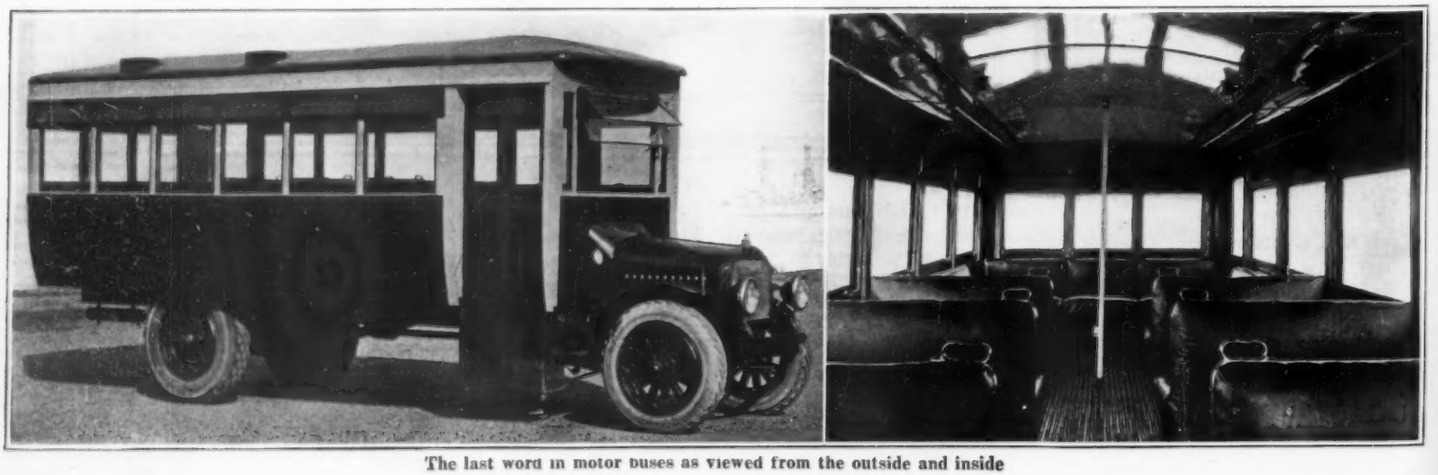
WHEELS with laminated wood disks are now manufactured for all types of motor vehicles. The disks are built up of thin, rotary-cut plies of wood glued together under pressure with waterproof glue. The grain of each layer runs in a different direction from that of the layer next to it. This process of lamination is said to make the complete disk very strong, non-warpable and resilient. The weight of these wheels is substantially the same as that of a spoked wood wheel, but the resistance to transverse shocks is said to be much greater. In order to render inflation of the pneumatic tire convenient, a patented angle connection is furnished, which goes on the tire valve stem and permits the tire to be inflated from the outside face of the wheel. The design of the wheel is such that the disk can readily be fitted to any standard hub and rim. These wheels are said to be stronger than the conventional wood spoke wheels of equal weight.

Use of Horses Becoming Less in Cities

THE Bureau of the Census, Department of Commerce, announces that 56,539 horses were reported in the City of New York at the census of 1920, as compared with 128,224 reported at the census of 1910. There has been a similar marked decrease in the number of horses in all the principal cities in the United States so far as heard from. Chicago had 30,388 horses in 1920, as compared with 68,122 in 1910; Philadelphia, 19,472 in 1920, and 50,461 in 1910. In Baltimore the number of horses reported at the censuses of 1920 and 1910 was respectively 7378 and 15,346; in Boston, 10,093 and 23,007; in Pittsburgh, 6032 and 12,845; in Cincinnati, 5031 and 13,901; in Cleveland 4924 and 16,839. The above figures may be taken as an index of the growing use of motor transportation, both for business and pleasure in various municipalities.

Gasoline Cars Keep Railway Operation Costs Down

THE Carrollton & Worthville Railroad Co., operating a strip of road ten miles long, is the only company operating in Kentucky which has not raised passenger fares since the depression period began. This company solved the problem by shelving its steam locomotives and substituting gasoline motor vehicles. The cars have attracted the attention of short line railroad companies as far south as Louisiana and as far west as New Mexico. Automobile manufacturers have studied them with a view to their practicability for adaptation to street car service. Operation of one of these cars for one round trip costs $2, counting repairs, labor, gas, oil and depreciation. The trip with a steam locomotive costs from $15 to $18. There can be no doubt as to the practicability of gasoline car service on small railroads and branch lines, and we can look for a continued increase.



The last word in motor buses as viewed from the outside and inside

Painting with Metal Spray

(*Continued from page 137*)

the ground that oxidation would prevent the formation of a homogeneous layer of protecting metal. Practical results contradict this assumption. It is true that in most metallurgical processes gas and air do affect melted metal and frequently bring about rapid oxidation; and on the face of it one might imagine that the same phenomena would occur with atomized, molten metals. But the speed with which fusing, projection, and "freezing" of the atomized metal takes place, in relation to the comparatively moderate temperature employed, is greater than the rate at which reaction would have to occur to induce oxidation. In other words, it is feasible to melt and to solidify a metal so quickly that there is not time enough for the absorption of oxygen or other gases. In proof of this, Schoop has fused lead and then sprayed it with a stream of compressed oxygen, obtaining thereby a normal, homogeneous layer of the metal without any trace of oxidation!

In Germany wooden tobacco pipes and the inner surfaces of beer kegs have been "metallized" to protect them against fire in one case and to make them tight and more durable in the other. Telegraph and telephone poles have had their buried ends and a section immediately above the ground sheathed with a film of lead to prevent rotting; and the blades of aircraft propellers have been coated with aluminum. Metal-spraying pistols are being used to surface with aluminum or copper aprons, smocks, gloves, etc., worn by workers in chemical factories and laboratories where the fabrics might otherwise absorb chemicals and become dangerously combustible if brought close to a flame. The point to be noted is that materials which are normally considered more or less inflammable can be covered with a skin of metal without being injured in doing so. Clay models and many other works of art can be gilded, silvered, coppered, bronzed, etc., by means of the Schoop apparatus. The work is of such a character and the texture so true to the nature of the metal that the eye is readily deceived as to the identity of the underlying supporting substance.

Housework in the Laboratory

(*Continued from page 130*)

tween sewing and sweeping and washing. Washing at the tables of varying elevations exacted different ratios of heat output: Twenty-one calories were required when the subject worked in a comfortable position, 25 calories when the pan was so stationed as to necessitate raising of the arms, and 30 calories when dishwashing was reduced to a back-bending job. The unpleasantness of the task was not broached by the experimental conclusions.

Laundry operations, both washing and ironing, were not outside the province of these observations. The work was done on towels 16 inches square. The washing equipment comprised a small galvanized iron tub and a scrubbing board, while the ironing was accomplished with a 5-pound iron on a table of suitable height. A towel was rubbed on the scrubbing board 40 times in 30 seconds, wrung by hand for 15 seconds, and then exchanged for another towel, 15 seconds being allowed for transferring. The energy output in washing was 49.6 calories per hour, thus earning for the assignment the classification of laborious toil. The presence of water in conducting the experiments would undoubtedly have increased the figures of heat requirement, as it would have enhanced the weight of the towel as well as wet articles would have offered more resistance on the scrubbing board and in wringing. Ironing proceeded at a rate of 70 strokes in 50 seconds, 10 seconds being allowed for exchanging towels. A cold iron was used lest heat should obstruct the measurements in the calorimeter. The energy expenditure was 24 calories an hour, thus ironing being classified as moderate toil.

The woman subject reposed in a common bentwood chair while knitting, crocheting, and hand sewing. Motions, other than those involved in the immediate task, were kept at a minimum. An uncompleted sweater was the object employed in the knitting operations, 23 stitches being administered to the minute. A simple pattern and fine cotton thread were used in the crocheting experiments. Hand sewing included varying types of work: Making a plain unpadded scallop (blanket stitch) on the edge of a small piece of fine linen, at the rate of 18 stitches a minute; simple running on light cotton goods, 6 stitches being taken on the needle, one to one beat of the time-measuring instrument, then the thread pulled through to four beats, with a total of 30 stitches per minute; hemming on light cotton goods, at a rate of 30 stitches to the minute, the thread being pulled all the way through after each stitch; darning light-weight cotton hose with a thread about 24 inches long. Such tasks entail a relatively small expenditure of energy, ranging from 7 calories an hour for sewing with the running stitch to 10 calories per hour in hemming. The heat output while knitting, 10 to 11 calories an hour, slightly exceeded that entailed in crocheting, 8 to 9 calories. The variation is attributed to the wool sweater being knitted weighing more than the cotton lace which was crocheted. Also a more liberal play of hand and arms was involved in knitting. The materials in hand sewing being approximately of the same weight the differences in heat expended are attributed to the extent of movement required. With a running stitch, 7 calories per hour, the movement of drawing the thread to its full length was made only every six stitches or five times a minute, whereas with hemming, 10 to 11 calories an hour, it was made after each stitch or 30 times a minute. Needleworkers, in practical operations, avoid the long thread because of undue exercising of the arms.

Advocates of modern conveniences in the home, it would seem, can draw an effective object lesson from these experimental conclusions which accurately determine energy expenditure in the performance of household tasks. Even under the most pleasing environments the housewife spends liberally of her reserve forces; when the home is devoid of modern facilities, certainly the toll exacted is not a mere calculation of effort wasted but a sacrificial exaction where human values pay dearly and even the tenure of life is abridged.

Simplifying the Coupling of Trains

(*Continued from page 131*)

Where this coupler is used the cars are coupled and uncoupled in the usual manner. The headpieces or mating members of the Futrell coupler are suspended beneath the present draw-bar coupler and are automatically forced and guided together by means of spring pressure and guide members extending on each side of the opposing head. The Futrell device maintains an airtight joint through its automatic self-locking coupler, and the gaskets meet just before the metal faces of the couplers touch, which allows for some axial play. This movement blocks the escape of steam or air and seals automatically any possible avenue of escape. The coupler's metal pipes, which carry the steam, air and signal system, are hinged to the ends of the other car pipes by means of universal joints. This allows plenty of room or play when the cars take curves or cause movements which necessitate more or less of the freedom for which the rubber hose makes room.

The Futrell coupler connects the steam, air, signal, electric light and telephone lines on the trains without men going between the cars or coaches to make the

Tools of Industry

In industry, art, science, in fact in all kinds of work, good results require good implements kept in good condition.

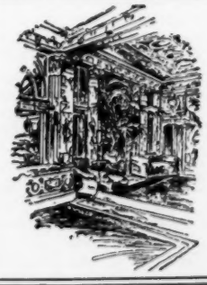
If the right sort of implement is important to an individual workman, efficient tools for industry and commerce are a vital necessity to the nation.

Telephone service is one of the tools of American industry and commerce in most common use and upon which much depends. The American public cannot afford to let this tool get dull.

To provide over twelve million subscribers with telephone connection; to transmit the vibrations of the human voice thirty million times a day and from any point to any other point throughout the land, demands an expensive mechanism of the highest order of scientific precision, and an efficient organization.

It is the aim of the Bell Telephone System, with the cooperation of the public, to be the most dependable tool of American industry.

"BELL SYSTEM"
AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES
One Policy, One System, Universal Service, and all directed toward Better Service



Fourteen East Sixtieth Street
New York City
An Exclusive Residential Hotel affording the Dignity and Elegance of a Private Residence. Opposite the Metropolitan Club and Fifth Avenue entrance to Central Park, with easy access to Clubs, Theatres and Shopping centres
Eager & Babcock

South Dakota State School of Mines
Rapid City, South Dakota
Has just closed the best year in its history. Few institutions have at their doorway such a wonderful outdoor laboratory as the Black Hills region.
Degrees are granted in Civil, Electrical, Mining, and Metallurgical Engineering.
Expenses are low and much attention is given the individual student. Write and let us tell you more about the advantages here provided. For catalog and book of views address, The President.

We Will Make It
Anything in a metal stamping or novelty produced from any metal and finished in any color.
Waterbury Button Co., Waterbury, Conn.

GAS, AIR, WATER, GASOLINE PUMPING
by vacuum or pressure of air with
LEIMAN BROS. AIR PUMPS
ROTARY—POSITIVE

Widely used for gasoline measuring pumps, printing press paper feeders, package wrappers, bottle filling devices, fuel oil heating outfits, gas furnaces and blow pipes, agitating chemical and other solutions, sand blasting, testing for leaks, vacuum cleaning, priming engines and pumps, milking, vacuum chucks, blowing away stampings and cuttings from presses and machines.
Catalog No. 264-T-16
LEIMAN BROS. 81 WALKER ST., N. Y.

Experimental and Model Work
Fine Instruments and Fine Machinery.
Inventions Developed.
Special Tools, Dies, Gear Cutting, Etc.
HENRY ZUHR, 489-93 Broome St., New York City

THE distribution of Bessemer Oil Engines is world wide. No other power equipment combines so many advantageous features. Less floor space needed, compactness and simplicity of design. No skilled labor required for its operation. These economics plus the low cost of operating on any grade of fuel oil make the Bessemer ideal for any power requirements 15 to 180 H. P. Write for catalog.

THE BESSEMER GAS ENGINE CO.
14 York Street, Grove City, Pa.
21

BESSEMER OIL ENGINES

Weber Crank-Pin Re-Turning Tool

NO FILING
NO OFFSETTING
NO JIGS

A precision tool which will improve and speed up your motor machine work. Crank Pins of automobiles, trucks and tractors can be re-turned with the highest degree of accuracy with one setting of the crankshaft in the lathe on centers. Each crank pin can be re-turned in from 5 to 20 minutes. **A micrometer dial** enables the operator to make each pin exactly the same size, and each pin when finished must be perfectly round and parallel with the rest. **The Weber tool** is guaranteed to turn crank pins within as close limits of accuracy as any other known method. It is being used in many production plants for finishing work on crank shafts. An assortment of cutters is furnished with each tool to fit the pins of popular motors.

Write for our folder, and book, "Proof"

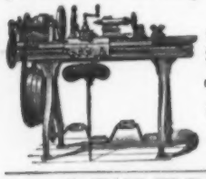
SAWYER-WEBER TOOL MFG. CO.
353 So. Alameda Street Los Angeles, Calif.

Lupton
STEEL SHELVING

Tool Stands, Tool Cabinets, Pressed Steel Bench Legs, etc.

Order from Warehouse Stock
DAVID LUPTON'S SONS CO.
Clearfield and Weikel Sts.
Philadelphia

For Gunsmiths, Tool Makers, Experimental & Repair Work, etc.



From 9-in. to 18-in. swing. Arranged for Steam or Foot Power, Velocipede or Stand-up Treadle.

W. F. & J. Barnes Co.
Established 1872.
1999 Ruby Street
Rockford, Ill.

ASBESTOS

We are miners and shippers of Crude Asbestos in any quantity. We produce all grades at our world famous BELL ASBESTOS MINES in Canada. We also carry fibres, spin yarns, weave cloths, and make all sorts of Asbestos products.

For anything you want in Asbestos, turn to
KEASBEY & MATTISON COMPANY
DEPT. S-1
AMBLER, PENNA., U. S. A.
Owners of the world's largest Asbestos Mines

You can be quickly cured, if you
STAMMER

Send 10 cents for 288-page book on Stammering and Stuttering, "Its Cause and Cure." It tells how I cured myself after stammering 20 yrs. **B. N. Bogue, 2955 Bogue Bldg., 1147 N. Ill. St., Indianapolis.**

connections. Any number of cars in a train can be connected in the same time as two cars are connected. And the coupling is done instantaneously or in the same brief period of time which is required for the draw-bars to come together. There is no waste of time as is the case where a brakeman must fumble in his crowded position connecting up the rubber hose.

The Futrell coupler is also uncoupled automatically when the cars are uncoupled. The lever which disconnects the heads of the draw-bar also releases the locking bars of the Futrell coupler, and this operation is just as simple and rapid as where the simple connection is made.

Mr. Futrell had his first couplers introduced on the passenger coaches of the Los Angeles & Salt Lake Railroad running between Los Angeles and San Bernardino, California. The couplers were in constant service on this line for an entire year during which time they rendered the most satisfactory results. Railroad men pronounced the test a complete success.

On August 21, 1919, the first train equipped with the new coupler arrived at the B. & O. railroad station at Frederick, Md., from Washington. The officials pronounced the trip a greater success than they anticipated. A decision was then made to place the coaches, thus equipped, in constant service for several months in order that a careful study could be made in cold weather. After several months of continuous service, or about March 1, 1920, the couplers, having been exposed to hard usage and subject to heavy strain, were found to be in excellent condition and they were highly praised by members of the railroad fraternity. The use of the couplers revealed some minor details which could be materially improved, and Mr. Futrell did not delay in making the improvements. The alterations did not change the mechanical principle of the coupler but only eliminated some parts of the mechanism that might wear and tear some of the moving parts.

The couplers in their improved form were installed on passenger coaches in service on May 1, 1920, on trains running between Washington, D. C., and Frederick, Md. These trial runs, which were made to test fully the improved Futrell couplers, are reported as entirely successful.

Winning Foreign Film Markets

(*Continued from page 132*)

Every European country is from six to ten years behind the times in the matter of film theaters and finds itself in much the same position as Great Britain or France. German motion-picture interests are frantically engaged in overhauling all manner of buildings for amusement purposes, so keen is the demand for motion-picture entertainment. The war did not deter German producers from keeping up their operations although their market was limited to Central Europe. Approximately 600 new and improved theaters will be placed in operation this year and next, it is said. There is scarcely a block in Berlin, Frankfort and other large cities without its motion-picture house, and exhibitors are frantically scouring about for new sites.

The estimated shortage of 20,000 theaters does not take into account such territories as India, China, Africa, Russia, Western Asia, the Balkans, Central America, and the hundreds of islands which dot the seas. China, were its motion-picture interests developed to 50 per cent of the standard maintained in America, would require more than 30,000 theaters alone. More than 100,000 new theaters will be required to enable the development of the world-wide film industry on anything like the scale attained in America.

Prior to the World War French and Italian films completely controlled the South American market. The war quickly snuffed out this business and the American companies stepped in with their product. The great majority of American pictures which had been shown in South America before this time could have been classified as "junk" and did not gain much respect for American films. In those days the majority of American exporters were careless or indifferent as to the possibilities to be gained in Latin America, and much of the film exported was from two to four years old.

The war enabled several aggressive American concerns to gain a foothold in South America with their modern, high grade photoplays, and American films quickly gained the dominant position in this market. Leading South American film men declare they will never go back to dependence upon European markets, as they have found the American films greatly superior to European productions. In 1919 a prominent exhibitor in Buenos Aires rebelled at the idea of having the door closed on French and Italian films and started a theater in which he proposed to show nothing but European pictures. His venture was a complete and speedy failure, for the fans of the capital could not be weaned away from their preference for American pictures.

Another striking illustration of the tremendous growth of the export business of the leading American companies is to be found in the case of the Australian business of one concern. Three years ago it started its Australian agencies with a total business of six per cent of all the films shown in Australasia. Today it has more than 65 per cent of the business and is continuing to grow.

Soap Science

(*Continued from page 133*)

Dr. Adolf Welter, of Crefeld (Germany), has now received a patent (Imp. Ger. Pat. 331715), whereby it is possible to make an almost odorless clay soap, containing a low percentage of sebacic acid, by a cheap and technically easy process. For this purpose liquid or solid soap is mixed in a kneading machine with clay or any other filler. This mixture, which does not even require a thorough mixing together, is then divided up into small porous pieces, for instance in a machine of suitable type. These are then dried, in drying chambers upon frames, until they are ready for crushing up into powder by means of rollers. This powder is then thoroughly and uniformly mixed together, and it can then be molded into pieces of suitable shape by means of mechanical or hydraulic presses working at a pressure of from 50 to 300 atmospheres.

The process here described (for coarsely crushing, drying and grinding the soaps with the filling materials, while in the first place avoiding the costly milling process and finally pressing the powder thus obtained into molds under high pressure) enables soda soaps to be made with less than 5 per cent sebacic acid and without the use of hard fats. These soaps are also far superior to milled soaps due to their low percentage of water and a specially low degree of increasing the bulk or "swelling."

Cement for Leather Driving Belts

AN extremely tenacious cement, consisting of 12 parts asphalt, 10 parts colophony, 40 parts guttapercha, 150 parts bisulphide of carbon and 60 parts petroleum, can be prepared as follows for fastening leather belts and the like. The materials, without the bisulphide of carbon, are first of all placed in a bottle standing in boiling water and worked up with petroleum for a few hours; when it has thickened suitably the mass is allowed to cool off, the bisulphide of carbon is then added and the whole is allowed to stand for some days, the bottle being frequently shaken. The belting is evenly coated with the cement and passed through warm rollers.

LEGAL NOTICES

PATENTS

IF YOU HAVE AN INVENTION which you wish to patent you can write fully and freely to Munn & Co. for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention and a description of the device, explaining its operation.

All communications are strictly confidential. Our vast practice, extending over a period of seventy years, enables us in many cases to advise in regard to patentability without any expense to the client. Our Hand-Book on Patents is sent free on request. This explains our methods, terms, etc., in regard to **Patents, Trade Marks, Foreign Patents, etc.**

SCIENTIFIC AMERICAN
Contains Patent Office Notes, Decisions of interest to inventors—and particulars of recently patented inventions.

MUNN & CO., SOLICITORS OF PATENTS
Woolworth Building, NEW YORK
Tower Building, CHICAGO, ILL.
Scientific American Building, WASHINGTON, D. C.
Hobart Building, SAN FRANCISCO, CAL.

Annual Subscription Rates
Scientific American Publications

Scientific American (established 1845) one year $6.00
Scientific American Monthly (established 1876) one year $7.00
Postage prepaid in United States and possessions, Mexico, Cuba and Panama.

Foreign Postage
Scientific American $1.50 per year additional.
Scientific American Monthly 72c per year additional.

Canadian Postage
Scientific American 75c per year additional.
Scientific American Monthly 36c per year additional.
The combined subscription rates and rates to foreign countries, including Canada, will be furnished upon application.
Remit by postal or express money order, bank draft or check.

AGENTS WANTED
AGENTS, $60 to $200 a week. Free samples. Gold Sign Letters for Store and Office Windows. Anyone can do it. Big demand. Liberal offer to general agents. Metallic Letter Co., 431X N. Clark St., Chicago.

BUSINESS OPPORTUNITY
$100,000 Corporation wants capable man; open office; manage sales for High Class New Device. Every Home a Prospect. Big money-making possibilities for the right man. Opening in every City. Costs $2.00, retails $5.00. $500 to $2,000 necessary to finance exclusive agency. Scott Corporation, 82 W. Washington, Desk O, Chicago, Ill.

BUSINESS OPPORTUNITY
YOU CAN have a business profession of your own and earn big income in service fees. A new system of foot correction; readily learned by anyone at home in a few weeks. Easy terms for training; openings everywhere with all the trade you can attend to. No capital required or goods to buy, no agency or soliciting. Address Stephenson Laboratories 23 Back Bay, Boston, Mass.

BUSINESS OPPORTUNITY
SUBSTANTIAL manufacturing corporation wants capable men to establish branch and manage salesmen. $300 to $2000 necessary. Will allow expenses to Baltimore as explained. Address, Mr. Clemmer, 603 N. Eutaw St., Baltimore, Md.

FOREIGN STAMPS
55 DIFFERENT STAMPS, including China, Japan, French Colonies, etc., given to applicants for our high grade approval selections. Send references and 2c stamp to the EDGEWOOD STAMP CO., Dept. G, Milford, Conn.

WANTED
OLD style Delaval steam turbine, 6-inch rotor wheel, jets and casing. Wm. J. H. Strong, Box 505, Chicago, Illinois.

FOR SALE
IMPORTANT and "going" hardware specialty. A fully developed, marketable and profitable mechanical device enjoying monopoly in the United States, protected by numerous and adequate patents. Capable of very large results if backed with sufficient capital. For full information, Box 132, Scientific American.

INVENTIONS DEVELOPED
MACHINE shop work desired. Special ability for developing inventions and labor saving machinery. Successful in many difficult projects. Correspondence invited. Martian Mfg. Co., 171 Washington St., Newark, N.J.

ICE MACHINES Corliss Engines, Brewers and Bottlers' Machinery
The VILTER MFG. CO.
989 Clinton Street Milwaukee, Wis.

1/4 H. P., 110 volts, A. C., 60 cycle, single phase, 1750 R. P. M. MOTORS
LARGE QUANTITIES NEW WASHING MACHINE MOTORS
$22.75 Each
MANUFACTURERS - DISTRIBUTORS
CHAS. H. JOHNSTON - Box 21 W. E. Pittsburgh, Pa.

Single Track Minds

You could call them mental lightweights—the men you meet frequently at dinner, or at the club or on the street—men who continue to talk shop after office hours. Their vision is just as broad as their particular business, and their conversation reflects the single track.

On the other hand, the person who is always well-posted in the general trend of commerce, politics, industry and science finds himself highly regarded by his associates in any clime. The well-read man knows his Einstein, Curie, H. G. Wells, Payne, Edison and Cobb as well as the stock quotations and price lists. And his presence is a decided asset wherever he goes.

Now in the general matters of science, inventions, engineering and industry—the great live issues of interest to everyone—the Scientific American publications are equipped to keep you posted accurately and thoroughly. They bring you the latest news in the advance of electricity and the wireless; they further scientific research in our industries; they explain the theories of the practical scientists and discoverers.

The Scientific American publications also bring to you the translations of important notices that are appearing in European periodicals on progress in engineering, astronomy, aeronautics, industry, mechanics, etc.

In the combination of the two publications, Scientific American and the Scientific American Monthly, you have both the current news of science, industry and engineering in easily digested form week by week, and the more comprehensive treatment each month.

To be a reader of the Scientific American publications is to be accurately and thoroughly advised in the big issues of world interest.

The Scientific American Monthly is a 96-page journal, yearly subscription for which is $7. The weekly Scientific American is $6 per year—52 issues. In combination the two subscriptions are $11 per year.

SCIENTIFIC AMERICAN PUBLISHING COMPANY

WOOLWORTH BUILDING 233 BROADWAY, NEW YORK, N. Y.

Make this Chart your Guide

for Correct Automobile Lubrication

Chart of Recommendations

(Abbreviated Edition)

How to Read the Chart:

THE correct grades of Gargoyle Mobiloils for engine lubrication of both passenger and commercial cars are specified in the Chart below.

A means Gargoyle Mobiloil "A"
B means Gargoyle Mobiloil "B"
E means Gargoyle Mobiloil "E"
Arc means Gargoyle Mobiloil Arctic

Where different grades are recommended for summer and winter use, the winter recommendations should be followed during the entire period when freezing temperatures may be experienced.

The recommendations for prominent makes of engines used in many cars are listed separately for convenience.

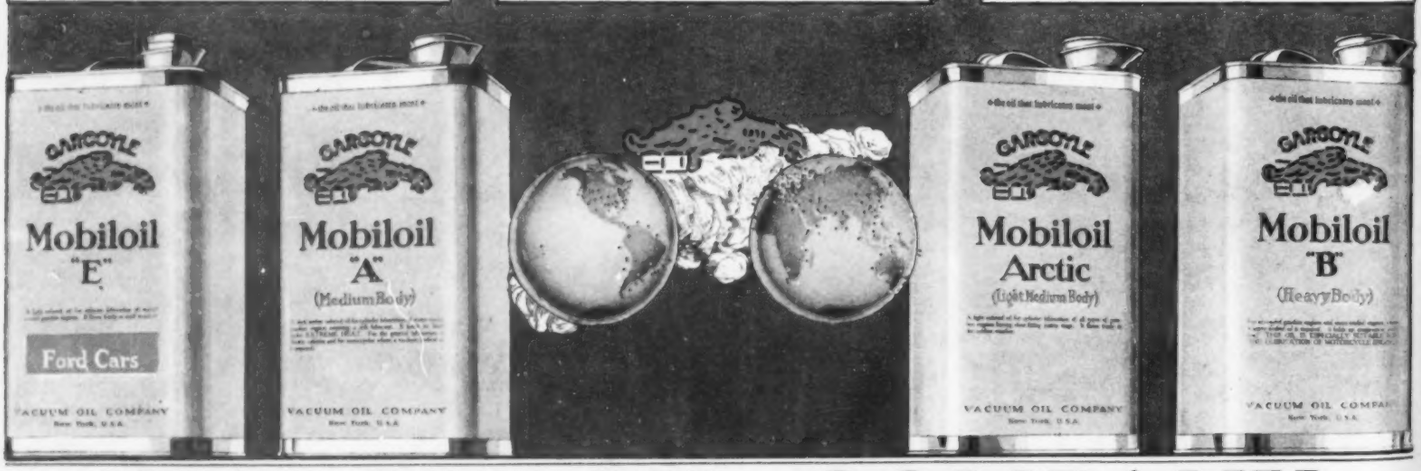
The Chart of Recommendations is compiled by the Vacuum Oil Company's Board of Automotive Engineers, and represents our professional advice on correct automobile lubrication.

NAMES OF AUTOMOBILES AND MOTOR TRUCKS	1921		1920		1919		1918		1917	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Acason (1 and 1½ ton)	A	Arc	A	Arc	A	Arc	A	Arc		
" (2 ton)					A	A	A	Arc	A	Arc
" All Other Models	A	A	A	A	A	Arc	A	Arc	A	Arc
Ace (Newark, O.) (1½ ton)	A	Arc	A	Arc						
" All Other Models	A	A	A	A	A	A				
Allen	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
American Six	A	Arc	A	Arc	A	Arc	A	Arc	Arc	Arc
Anderson	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Apperson (8 cyl.)	A	A	A	A	A	A	A	A	A	A
" All Other Models							A	A	Arc	Arc
Armleder (1 ton)	A	A	A	A						
" All Other Models	A	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Atterbury (Mod. B-E)	A	A	A	A	A	A				
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Auburn (6 cyl.)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (6-50)									A	Arc
"(6-39-B) (Tetrolet Eng.)							A	Arc		
Autocar	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Beaumer	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Bethlehem (2½ ton)							Arc	Arc	A	Arc
" All Other Models	A	A	A	A	A	Arc	Arc	Arc	Arc	Arc
Biddle			A	Arc	A	Arc	A	Arc	A	Arc
Bour Davis	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Brewster	B	A	B	A	B	A	B	A	B	A
Briscoe	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Brockway (3¼ ton)	A	Arc								
" (5 ton)	A	A	A	A	A	A				
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Buick	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Cadillac	A	A	A	A	A	A	A	A	A	A
Case	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
Chalmers	A	A	A	A	A	A	A	A	A	A
Chandler Six	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Chevrolet (8 cyl. Model)			A	A	A	A				
" (Model 490)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" All Other Models	A	Arc	A	Arc	A	Arc	A	Arc		
Cleveland	A	Arc	A	Arc						
Clydesdale (5 ton)	A	A	A	A	A	A				
" All Other Models	A	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Colt	A	A	A	A	A	A	A	A	A	A
Columbia (Detroit)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Comet	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc	A	Arc
" (Commercial)					A	Arc				
Concord	A	A	A	A	A	Arc	A	Arc	A	Arc
Corbitt (5 ton)	A	A	A	A	A	Arc	Arc	Arc		
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Crow-Elkhart	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Cunningham	A	A	A	A	A	A	A	A	A	A
Daniels	A	A	A	A	A	A	A	A	A	A
Dart (1 ton)			A	Arc	Arc	Arc	A	Arc		
" (1½ ton)	A	Arc								
" All Other Models	A	A	A	A	A	A	A	A	A	Arc
Davis	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Denby (Model U)									A	Arc
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Dixie Flyer	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Dodge Brothers	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Do	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Elcar (4 cyl.)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (6 cyl.)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Elgin	A	Arc	A	Arc			A	Arc	A	Arc
Erie (Erie, Pa.)	A	A	A	A	Arc	Arc	Arc	Arc	Arc	Arc
Essex	A	Arc	A	Arc	A	Arc				
Federal (Model S-X)							A	A	A	A
" (Special)							Arc	Arc		
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	A	A	Arc	Arc
Fiat							B	B	A	A
Ford	E	E	E	E	E	E	E	E	E	E
Four Wheel Drive	A	A	A	A	A	A	A	A	A	A
Franklin	A	A	A	A	A	A	A	A	A	A
Gardner	A	Arc	A	Arc						
Garford (2 ton)	A	A	A	A	A	Arc	A	Arc	A	Arc
Garford (3½, 5, 6 ton)	A	A	A	A	A	A	A	A	A	A
" All Other Models	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
G. M. C. Trucks	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Gramm-Bernstein										
(2½, 3½, 5 ton)	A	A	A	A	A	Arc	A	Arc	A	Arc
" All Other Models	Arc	Arc	Arc	Arc	A	Arc	A	Arc	A	Arc
Grant (6 cyl.)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (Com'l.) (Mod. 12)					A	Arc				
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc				
Gray Dort			A	Arc	A	Arc	A	Arc	A	Arc
Hahn	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Hal-Fur	A	A	A	A	A	A				
Harroun			A	Arc	A	Arc	A	Arc	A	Arc
Haynes (6 cyl.)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (12 cyl.)	A	A	A	A	A	A	A	A	A	A
H. C. S.	A	A	A	A						
Holmes	A	A	B	A						
Hudson Super Six	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Hupmobile	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
I. H. C.							A	A	A	A
Indiana (1 ton)					A	Arc	A	Arc	A	Arc
(1½ ton)	A	Arc	A	Arc						
" (2 ton)	A	A	A	A	A	A	A	A	A	A
" (5 ton)	A	A	A	A	A	Arc	A	Arc	A	Arc
" All Other Models	A	A	A	A	A	A	A	A	A	Arc
International	A	A	A	Arc	A	Arc	A	Arc	A	Arc
Jackson (4 cyl.)	A	Arc	Arc						Arc	Arc
Jackson All Other Mods.	Arc	Arc	Arc	Arc			A	A	A	A
Jones			Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
Jordan	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Kelly-Springfield	A	A	A	A	A	A	A	A	A	A
Kenworthy (4 cyl.)	A	A	A	A						
" (6 cyl.)	Arc	Arc	Arc	Arc						
King (8 cyl.)			A	A	A	A	A	A	A	A
Kissel Kar (12 cyl.)							A	A	A	A
" All Other Models	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Kline Kar	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Koehler (Models M & MT)	A	A	A	A	A	A				
" All Other Models	A	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
LaFayette (Indianapolis)	A	A	A	A						
Lange	A	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Lexington (Conn'l. Eng.)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Liberty	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Lincoln	A	A								
L. M. C.	A	Arc								
Locomobile	A	F	A	E	A	E	A	E	E	E
Maccar (5½ ton)	A	A	A	A	A	A	A	Arc	Arc	Arc
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Mack	A	Arc	A	Arc	A	A	A	A	A	A
Madison (6 cyl.)					A	Arc	A	Arc	A	Arc
(8 cyl.)									A	A
Malcolm	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Marmon	A	A	A	A	A	A	A	A	A	A
Maxwell	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
McFarlan	A	A	A	Arc	A	Arc	A	Arc	A	Arc
Mercer	A	A	A	A	A	A	A	A	A	A
Mitchell	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
M. H. M.	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Monroe (Model M-3)					A	Arc	A	Arc	A	Arc
" All Other Models	A	A	A	A	A	A	A	A	A	A
Monitor	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Moon	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Nash	Arc	Arc	A	Arc	A	Arc	A	Arc		
" (Model 671)							A	Arc		
" (Com'l.) (Quad)	A	A	A	A	A	A	A	A		
" (1 ton and 2 ton)	A	Arc	A	Arc	A	Arc	A	Arc		
National (6 cyl.)	A	A	A	A	Arc	Arc	Arc	Arc	Arc	Arc
" (12 cyl.)					A	A	A	A	A	A
Nelson	A	A	A	A	A	A	A	A	A	A
Netco	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Noble	A	A	A	A	Arc	Arc	Arc	Arc	Arc	Arc
Noma	Arc	Arc	Arc	Arc	Arc	Arc				
Oakland	A	A	A	A	A	A	A	A	Arc	Arc
Old Hickory	Arc	Arc	Arc	Arc	A	Arc	A	Arc	A	Arc
Oldsmobile (4 cyl.)	A	Arc	A	Arc	A	Arc				
" (6 cyl.)	A	A	A	A	A	A	A	A	Arc	Arc
" (8 cyl.)	A	A	A	A	A	A	A	A	A	A
Overland	A	Arc	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Owen Magnetic (Mod. M25)							Arc	Arc	Arc	Arc
" All Other Models	A	A	A	A	A	A	A	Arc	A	Arc
Packard	A	A	A	A	A	A	A	A	A	A
Paige (6 cyl.)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (Continental Eng.)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" All Other Models	A	A	A	A						
Paterson	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Peerless (8 cyl.)	A	A	A	A	A	A	A	A	A	A
" All Other Models							Arc	Arc	Arc	Arc
Phianna	A	A	A	A	A	A	A	A	A	A
Pierce-Arrow	A	A	A	A	A	A	A	A	A	A
" (Com'l) (5 ton)	A	A	A	A	A	A	Arc	Arc	Arc	Arc
" " All Other Models	A	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Porter	A	Arc	A	Arc	A	Arc				
Premier	A	A	A	A	A	A	A	A	A	A
Ramer (1½ ton)	Arc	Arc	Arc	Arc	Arc	Arc				
(1½ ton)	A	A								
" All Other Models	Arc	Arc	Arc	Arc	A	Arc	A	Arc	A	Arc
R & V Knight	B	A	B	A						
Renault (French)	A	A								
Reo	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Republic (1 and 1½ ton)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" All Other Models	Arc	Arc	Arc	Arc	A	Arc	A	Arc	A	Arc
ReVere	A	A	A	A	A	A	A	Arc		
Rosenbe (Model R. A.)									A	Arc
(Model 4-75)	A	A								
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc			Arc	Arc
Rock Falls	A	Arc	A	Arc	A	Arc				
Rolls-Royce (British)							A	A		
Saxon	A	Arc	A	Arc	E	E	E	E	E	E
Sayers-Scott	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Schacht (5 ton)	A	A	A	A	A	A	A	A		
" All Other Models	A	A	A	A	A	A	Arc	Arc	A	Arc
Scripps-Booth (4 cyl.)							Arc	Arc	A	Arc
" All Other Models	A	A	A	A	A	A	A	A	A	A
Selden (3 ton)									A	Arc
(5 ton)	A	A	A	A	Arc	Arc	Arc	Arc		
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Seneca	A	Arc	A	Arc	A	Arc	Arc	Arc		
Service (2 ton)	A	Arc	A	Arc	A	Arc	A	Arc		
" (20, 130, 140, 170)									A	Arc
" All Other Models	A	A	A	A	A	A	A	A	A	A
Simplex Crane							A	A	A	A
Standard (8 cyl.)	A	A	A	A	A	A	A	A	A	A
Stearns-Knight	B	A	B	A	B	A	B	A	A	A
Stephens	A	A	A	A	A	A	Arc	Arc	Arc	Arc
Stevens-Duryea	A	Arc								
Stewart (Buffalo)										
(Com'l.) (¾ ton)			A	Arc	A	Arc	A	Arc	A	Arc
" (1 ton)			Arc	Arc	A	Arc	A	Arc	A	Arc
" (Models 7s & 10s)	A	A	A	A						
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
Stoughton (1 ton & 1½ ton)	A	Arc	A	Arc						
" All Other Models	A	A	A	A						
Studebaker	A	A	A	Arc	A	Arc	A	Arc	A	Arc
Stutz	A	A	A	A	A	A	A	A	A	A
Sullivan	A	A	A	A	A	A	A	A	A	Arc
Templar	A	A	A	A	A	A	A	A		
Traffic	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
United (Mich.)										
(2½, 4, 5, 6 ton)	A	A	A	A	A	A	A	A	A	A
" (1½ ton)	A	A	A	A	A	A	A	Arc		
" All Other Models	A	A	A	A	A	A	Arc	Arc		
Velie (Model 34)	A	Arc	A	Arc						
(Com'l) (1¼ ton)					A	Arc	A	Arc		
" All Other Models	A	Arc	A	Arc	A	Arc	A	Arc		
Vim (Mod. 22, 23 & 24)	A	A	A	A	A	A				
(Model 25)	A	A	A	A	Arc	Arc				
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Westcott	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
White Hickory	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
White (16 valve)					A	A	A	A	A	A
(3 and 5 ton)	A	A	A	A	A	A				
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Willys-Knight	B	A	B	A	B	A	B	A	A	A
Willys Six					Arc	Arc	Arc	Arc	Arc	Arc
Wilson	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Winther Six	A	Arc	A	Arc						
(Com'l) (¾ ton)	A	Arc								
" All Other Models	A	A	A	A	A	A	A	A	A	A
Wintun	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc

These recommendations represent the professional advice of the Vacuum Oil Company as determined by its Board of Automotive Engineers.

Prominent Makes of Engines

Beaver (Mod J-JA-JB-JC	A	A	A	A	A	A	A	A		
" All Other Models	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Buda (Mod ATU-BTU-CTU-DTU-ETU-FTU-HU-HTL-IL-ITU-XU-XTU-VU-VTU)	A	A	A	A	A	A	A	A	A	A
" All Other Models	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Continental (Model B2)	A	A	A	A	A	A				
(Model T)					A	Arc	A	Arc	A	Arc
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Falls	A	A	A	A	A	A	A	A	A	A
G.B. & S. (Model AA)	A	A	A	A	A	A				
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Herschell-Spillman (Models JU-S-V & VA)					A	A	A	A	A	A
" All Other Models	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Hinkley	A	A	A	A	A	A				
Northway (Mod. 100)							Arc	Arc		
" All Other Models	A	A	A	A	A	A	A	A		
Waukesha (Models CU-DU-EU & FU)	A	A	A	A	A	A				
" All Other Models	A	A	A	A	Arc	A	Arc	A	Arc	A
Weidely	A	A	A	A	A	A	A	A	A	A
Wisconsin (Mod. Q & QU)					A	Arc	A	Arc	Arc	Arc
" All Other Models	A	A	A	A	A	A	A	A	A	A



VACUUM OIL COMPANY

DOMESTIC BRANCHES: New York (*Main Office*) Detroit Boston Indianapolis Minneapolis Pittsburgh Buffalo Kansas City, Kan. Philadelphia Des Moines Chicago Dallas